Environmental Explorations

Learning the environmental way

Ontario
Ministry of the Environment

Hon. Keith C. Norton, Q.C., Minister

Gérard J. M. Raymond, Deputy Minister

PREFACE

For five years the Ontario Ministry of the Environment has been offering a unique educational program during the latter part of the school year and the summer months to schools, parks and camps around the Province known as Environmental Explorations. The program consists of a series of studies conducted by Ministry-trained university summer students and is designed to foster a clear awareness of and concern for the environment, to encourage an appreciation of the out-of-doors among people, and to motivate individuals of all ages to actively participate in environmental improvement and protection.

This manual incorporates the study plans utilized in the delivery of the program. Nine units are included, any or all of which may be undertaken by a teacher or camp/park counsellor for the benefit of those under their tutelage. The studies include field/forest, environmental games,aquatic habitat, nature, soil, litter, insects, acid rain and rainy day activities. Any of the units may be reproduced without further permission with an appropriate acknowledgement to the Ministry.

Should any additional information be required on the studies, or more specifically the Environmental Explorations Program, please contact the Public Affairs and Education Section, Communications Branch, at the Ontario Ministry of the Environment, 135 St. Clair Ave.,W., Toronto, Ont. M4V 1P5.

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FIELD/FOREST STUDY

INTRODUCTION

In this activity, campers are put in contact with terrestrial communities. By exploring an area of a field or forest for plant and animal life and by looking at the physical environment, children are made aware of the interactions between these components. The old field (or lawn) environment is compared to the forest environment. Similarities and differences are discussed.

OBJECTIVES

(1) To develop a better understanding and appreciation of field and forest communities.
(2) To develop skills in conducting field studies.

CONCEPTS

(1) Animals and plants can be found in any site, no matter how small.
(2) Physical factors affect which plants and animals life in an area. In return, the plants and animals affect the physical factors.
(3) Every organism, plant and animal, has unique adaptations to promote its survival.

PRE-FIELD TRIP PREPARATIONS

If instructors are unfamiliar with field trips a good guide to read previously is A Teachers Handbook for Study Outside the Classroom (Merrill Pub. Co.)/

Choosing a Field Site

Prior to beginning the field activities, the instructor should decide on a site where the group will carry out its investigations. It will be more beneficial to the campers if the quadrants under study differ

in some way. Quadrants set up under trees will reveal a different community than ones set up on a hill or an open field. Both a field and a forest are necessary to make this comparative study. Both areas should be free of dangerous objects.

Clothing and Equipment Required by the Student

1. Comfortable walking shoes (boots if bad weather).
2. Socks.
3. Jacket or sweater if cool weather.
4. Rain gear if unfavourable weather.
5. Shorts or slacks for all students depending on weather.
6. Pen and clipboard.

Note: It is stressed that the study is held outdoors unless the weather is so unfavourable that such an endeavour would be detrimental. In this case the study will be replaced by rainy day indoor activities.

Activities Beforehand

Instructors should become familiar with the ecological principles involved. See Appendix I. These include characteristics of the two sites (field and forest), succession and niches.

For All Ages:

(1) Introduce basic concepts: characteristics of fields and forests; parts of a plant or tree; introduce the terms sucession and niches. Depending on the age level, keep this aspect low key. A simple lesson could involve a brief discussion or spelling words that will be used in the field.

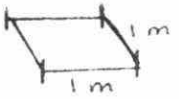
Equipment Required

Materials:

(1) meter sticks: one per team

(2) sets of 4 tent pegs or sticks and string to make a quadrant: one per team.

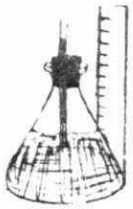
QUADRANT: Use the 4 pegs for corners of a square 1 m x 1 m. Tie the string around the 4 pegs as shown in the diagram.



(3) magnifying glass: one per team

(4) thermometer: one per instructor.

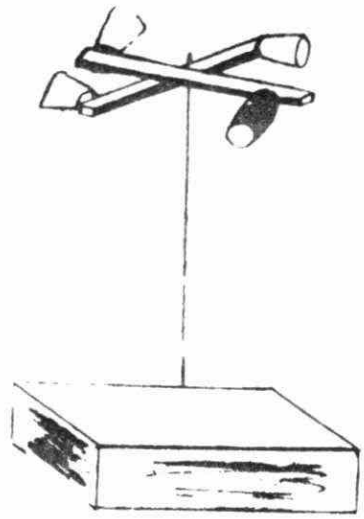
THERMOMETER: Insert a glass tube through the hole in the stopper on the bottle. Mark the bottle where the glass tube ends, then fill the bottle with red coloured water to 2.5 - 3.0 cm above the mark. Calibrate the thermometer by comparing it to another thermometer and place the readings on the cardboard attached to the bottle.



(5) anemometer: one per instructor.

ANEMOMETER: equipment: 4 paper cups, a drill, some brads, a medicine dropper, a coat hanger, 2 strips of wood, a block of wood.

Procedure and explanation: **Bend the coat hanger into an 'L' shape** and attach the short part of the 'L' to the block of wood with brads. Put the 2 strips of wood together to form a '+' then nail together. Drill a hole through thecenter of the '+' and run the medicine dropper through the hole. Place the wide end of the medicine dropper overtop of the wire hanger then seal the opposite end of the dropper by heating it. Fasten the cups to the wood strips after painting one of the cups. The cups will turn freely in the wind.



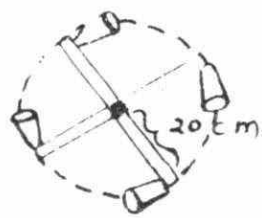
To calculate the wind speed (cm/minute) count the number of times the painted cup went around in one (1) minute. To calculate the distance the cup travelled in 1 turn around, measure the distance in centimeters (cm) from the hole in the '+' sign to the center of the cup and multiply that value by 6.28. To calculate the total distance the cup travelled in one (1) minute (i.e.: wind speed), multiply the number of times the cup went around in one minute by the distance of once around.

Example: In 1 minute, Sally saw the painted cup pass by 10 times.

The distance the painted cup travelled once around was: 6.28 x 20 cm = 125.6 cm.

The wind speed was: 10 times around/minute X 125.6 cm/once around

= 1256 cm/minute



(6) clipboards, pencils: clipboards of thin plywood or heavy cardboard with a pencil attached are needed for each person.

(7) trowels: 1 per team

(8) study sheets: one for each person. See Appendix II.

(9) summary chart: 70 cm x 100 cm, one per instructor. See Appendix III.

(10) Field guides: on trees, wildflowers, moss, grass, ferns, lichens, insects. (optional) An excellent reference is Terrestrial Ecology by W.A. Andrews, Prentice-Hall Publications, 1974. Also see Appendix IV.

FIELD TRIP ACTIVITIES

(1) Have the children look around and count the number of different areas they see. Working in teams, usually 2 or 3 children per team, they set up a quadrant in the area chosen, then answer the questions on their study sheets (see Appendix II a) & b)).

Encourage plots in the forest area that include a tree, not just a clear area. Random selection is important. For older children, the height of a tree will be measured. Instructions are as follows.

MEASURE HEIGHT OF A TREE

Season: Exercise can only be done when the sun is shining.

Objective: At the end of this exercise, the student should be able to:

(a) Use three known related values and by using ration and proportion derive a fourth related value.

(b) Take the length of a yardstick's shadow and the length of a tree's shadow, and by using ratio and proportion, find the height of the tree.

Materials: Yardstick and tape measure (measured pace).

Procedure:

1. Select the tree(s) to be measured.
2. Hold the yardstick at right angles with (perpendicular to) the ground.
3. Measure the length of the yardstick's shadow using a tape measure or pace measure
4. Measure the length of the tree's shadow by same method.
5. Using the following proportion

$$\frac{\text{length of yardstick}}{\text{length of yardstick's shadow}} = \frac{\text{height of tree}}{\text{length of tree's shadow}}$$

Place the measured values in their appropriate places. Multiply the yardstick's length times the length of the tree's shadow and divide this by the length of the yardstick's shadow. This gives the tree's height.

6. Repeat the above two steps for all other trees that are to be measured.

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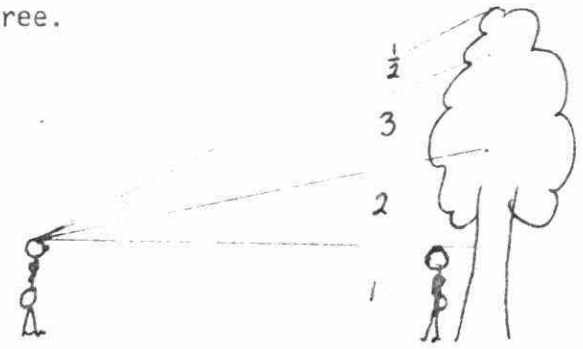
An estimate can also be made by standing one child (of a known height) directly beside a tree and setting another person on a distance to estimate how many "heights" it would take to make up the tree.



3-1/2 heights = 1 tree

If child's height is 1.5 metres, then the tree is

3.5 x 1.5 = 5.25 m.

For very young children, have them observe the things in the quadrant through guided questions from the study sheet in Appendix Ia).

Instructors should visit each team. Carry the wind meter (anemometer) and thermometer. Assist the campers in measuring the wind speed and in completing their study sheets.

(2) If the children wish to identify some plants or animals in their quadrant, I.D. sheets can be found in Appendix IV). A tree guide may also be useful (Trees of Canada or a Golden Guide).

(3) Call all the teams together. Compare the results found between field and forest quadrants on the summary chart. (Appendix III) Discuss why similarities or differences exist (See background information for instructors -- Appendix I).

FOLLOW-UP ACTIVITIES

For younger children

(1) Carry out a more specific study on one type of plant, e.g.: Dandelions. See the "Population of Dandelions" study done by the North York Board of Education (Follows).

(2) Draw a picture or write a story about the life of an ant in the grassy jungle.

For older children

(1) Draw a food web using the organisms found in the quadrant.

(2) Take a population count of all plants or animals found in the area. Draw graphs and quantitatively compare the field and forest areas.

(3) Study plant succession in the field.

A lesson plan follows.

POPULATION OF DANDELIONS

Name: _____

Problem: To find out how many dandelion plants there are in 10 square meters of a field.

Method:

1. Mark an area of ten square meters with stakes and string. Divide into ten plots of one square meter each.
2. Working in teams of 2, count the number of dandelions in your plot.

   Number: _____

3. How many dandelions in the 10 square meters?

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4. Compare results of each plot. Discuss why more dandelions in one plot than another.
5. How many seeds? Count the number of seeds on at least 10 dandelions. Find the average by:

   Average # seeds per flower: $\frac{\text{total seeds on 10 flowers}}{\text{10 flowers}}$

   How do the seeds travel?

EXERCISE: PLANT SUCCESSION

Aim:

To show the change in vegetation in one area over a period of 125 years.

Concepts:

1. As different plants come into an environment the environment changes.
2. As the environment of a plant changes, the plant becomes better suited or poorer suited to the environment.
3. When the environment of the plant becomes too unsuitable, the plant will die.
4. The replacement of one plant by another over a period of time follows a predictable pattern.

Vocabulary:

1. Environment
2. Succession
3. Ecology
4. Climax vegetation
5. Shade tolerant

Evaluation:

1. How do plants affect environment?
2. How do animals affect environment?
3. What are some other factors influencing environment?
4. What is ecology? Give examples.

Procedure:

1. Locate a grassy, open field near a forest.

   a. If a piece of open land in the eastern U.S. is left completely alone by man, it will eventually be covered by large timber. This process may take up to 125 years.

      The purpose of this lesson is to demonstrate the various stages of a piece of land goes through over this 125-year period. At each stop, you must imagine that you are looking at this original piece of land at some future date.

   b. This is what the land looks like in 1968.

   c. What is the vegetative cover? Answer: Grasses

   d. We are now ready to take a time machine trip into the future.

2. Locate an opening similar to that above but covered by brush or saplings two to five years old.

   a. This is 1971.

   b. Do you think these plants have heavy or light seeds:
   NOTE: Pine, sumac, elm, and sassafras are typical light-seeded plants; oak, and hickory are heavy seeded plants.

   c. Why do most of the plants here have this type of seed?
   Answer: Oak and hickory seeds fall, roll, or are carried by squirrels to their locations; thus they are usually close to a parent tree. Pine, sumac, elm, and sassafras are blown or carried by birds to their location; thus they may be found far from the parent tree.

   d. Note the understory plants. There are still many grasses and weeds growing here.

3. Locate an area which was once open but now has trees 6 to 12 years old on it (6 to 12 feet tall).

   a. This is 1976.

   b. Note the understory. Are there many grasses and weeds, or have these been replaced by different plants? Why? Answer: The environment has changed; there is no longer adequate sunlight for the original vegetation.

   c. What is this replacement of one type of vegetation by a different type called? Answer: Plant succession.

   d. What are some other factors that may have influenced the change in vegetation?

      Answer:

      (1) Animals could have influenced the change. For example: A sudden increase in the rabbit population here due to the filling of Lake Barkley resulted in a shortage of food. The rabbits almost completely eliminated the sumac for one season and much of it failed to come back because the sweetgum took its place.

      (2) Fire (none occurred on this particular location).

      (3) Others

   e. The total relationship between a plant and its environment is known as plant ecology. What are some of the environmental factors we have covered thus far?

      (1) Competition between plants for light and moisture.

      (2) Influence of animals on plants.

4. Locate an area once open but now covered with trees four to six inches in diameter.

   a. This is 1981, the trees are 12 to 15 years old.

   b. Note the understory. There is very little sumac and similar species left.

c. Observe the overstory. Trees with short lives such as sassafras look unhealthy if there are even any left. Slower growing trees are overtopped and are losing the battle for moisture, light, and minerals. Competition among plants of the same species is evident.

5. Locate an area once open but now covered with pole-sized trees (4 to 10 inches in diameter).

a. This is 1991, the trees are 15 to 30 years old.

b. How many different species of trees are there left in the overstory? Answer: The overstory consists almost entirely of oaks and hickories--the short-lived trees have died out.

c. How many understory species are left? Answer: The understory is almost bare because very little sunlight and moisture is available.

6. Locate a stand of small sawtimber-size trees (12 to 16 inches in diameter).

a. This is 2023, the larger trees are 50 to 60 years old.

b. Are there more or less small trees and brush in the understory than there was in the pole stand?

c. Why? There are more small trees because the environment has developed to the point where it is favorable for the growth of shade-tolerant plants. Maple and pawpaw are two examples of trees that can live under the shade of larger trees.

d. Why are some of the smaller specimens of sun-loving plants such as oaks and hickories dying? They are less vigorous trees that cannot tolerate the competition for light or moisture. This natural thinning gives the stronger trees more room to grown.

e. Why are some of the overstory trees considerably larger than others?

Answer:

(1) Some of the smaller trees are the same age as the larger ones but are losing the battle for moisture and light.

(2) Some of the smaller trees came in to fill in space after short-lived trees such as sumac and sassafras died out.

7. Locate a stand of large mature sawtimber (16 inches and larger in diameter).

a. This is 2093, the largest trees are about 125 years old.

b. Are there more or less understory trees than in the small sawtimber stand. Answer: More.

c. Why?

(1) Some of the larger trees have died creating open spaces. There was an abundant supply of seeds on the forest floor to take advantage of the available light and moisture.

(2) Many supressed trees live as inconspicuous seedlings until the overstory starts to open up. These supressed trees are large enough to be noticed now.

d. Do you think that the small timber in this stand will grow as tall and straight as the small timber growing on an old field? Why? Answer: Many of these trees have crooked tops and poor form because they were suppressed so long.

e. Predict how this area will look in another 100 years without any management.

Answer:

(1) Trees of all ages present.

(2) More shade-tolerant trees in the overstory.

(3) More heavy-seeded than light-seeded plants.

8. Forest management includes manipulating the ecology of an area to produce the most desirable trees. Some of the ways this is done include the following:

a. By harvesting groups of trees to create openings. Even-aged groups of sun-loving trees will soon become established in these openings.

b. By cutting or chemically killing undesirable trees.

c. If this area were covered with pine trees, man could keep it in pine by burning off the understory every two to five years. Pines are much more resistant to fire than hardwoods.

d. By harvesting the less vigorous trees before the entire stand is mature, man can improve the growth of his best trees by giving them more light and moisture. At the same time, man can get income from his tree crop before it is fully ripe.

LEVEL: EIGHTH AND TENTH GRADES

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(4) Bring the study sheets back to the classroom and discuss the data.

Studying the Data: The data gathered by each team must be exchanged with other teams. This can best be done by placing team data on stencils from which copies can be made for all members of the class. Team leaders should devise a form that will permit easy comparison.

Here is a sample of questions you should consider:

1. What producers are in the community? This can be answered by using general terms like "trees", "shrubs", etc., or by naming the various species in your list.
2. Are producers abundant or rare? This may be answered in general terms or with density figures.
3. If there are different groups of producers, which one of them seems to contribute the most toward producing food?
4. Are there layers of producers? If so, what relationships can you find between producers in different layers?
5. Does the community produce all its own food, or is food carried in from beyond the community boundaries? What evidence do you have for your answer?
6. What consumers are in the community? This, too, may be answered with such general terms as "insects," "spiders," "birds," etc., or with names of identified species.
7. Which consumer orders (first, second, etc.) are represented? What evidence can you point out that supports your answer?
8. If some quantitative data have been obtained, what relations can you find between the numbers of a particular organism and the numbers of another organism that eats it?
9. Besides evidence of food relationships, what evidence do you have that any one species in the community affects another?

A survey of a community should raise more questions than answers. In studying the data, part of the job is to look for questions that need answering.

From Environmental Education, Paducah P.S., Kentucky.

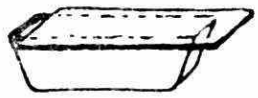
For all ages

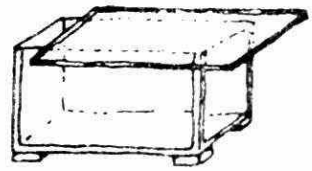
(1) Terrarium Project.

YOU WILL NEED:

Container with **Lid.**
Pebbles (or **Sand**), well washed.
Charcoal (briquets will do)
Leaf Mold or good **Topsoil**

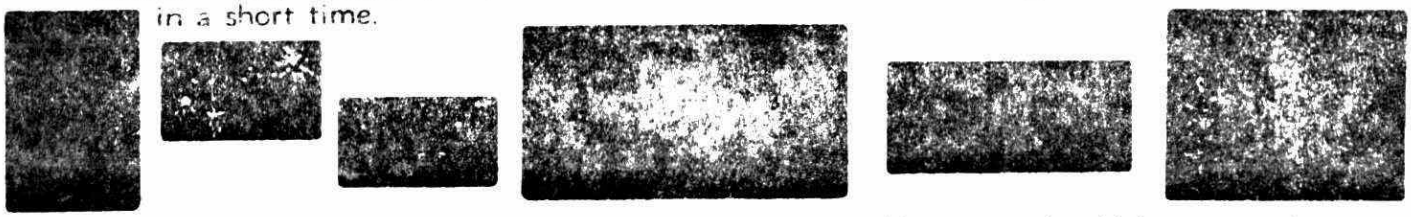

WIDE-MOUTHED JAR


REFRIGERATOR DISH


GLASS TERRARIUM

WHAT TO PUT IN:

Plants -- Tiny woodland ones that are **common** and will not outgrow the terrarium in a short time.



Warning: watch fungi and lichens as they may start molds which should be removed from the terrarium, unless you want to make a mold garden.

HOW TO ARRANGE IT:

1) First a layer of small pebbles or sand for drainage
2) Then a few pieces of charcoal, broken small
3) A layer of leaf mold or topsoil
   A small hill in the background or a rock ledge will add interest
4) Then add plants.

SUITABLE ANIMALS:

Salamander, small frog or toad, cricket, small snake or turtle.

They will need:

WATER -- Supply drinking water or a pond for animals. Sink into the soil a dish the correct depth and size for the animal. Keep mosses away from the edge of the water dish. Keep water clean, and remove uneaten food promptly.

SHELTER -- Animals need hiding places, too: a piece of wood, a branch, a rock, or part of a flower pot.

GENERAL SUGGESTIONS:

Keep terrarium out of direct sunlight and away from radiators.

Keep it moist and covered with a lid. If too moist, or if mold appears, leave container uncovered for a short time each day. Check to be sure it does not become too dry

REFERENCES:

The Terrarium, Audubon Nature Bulletin, pub. by National Audubon Society, 1130 5th Ave., New York 28, N. Y.

Small Pets from Woods and Fields, Margaret Waring Buck, N. Y., Abingdon Press 1960.

The School Terrarium, Turtox Service Leaflet No. 10 pub. by Turtox Service Department, General Biological Supply House, 8200 So. Hoyne Ave., Chicago 20, Ill.

(2) Repeat the study over the four seasons recording the changes that occur. This can also be done in differing environments (i.e. weather changes, biome changes).

(3) Do a spring wildflower puzzle.

SPRING WILDFLOWER PUZZLE

1. Its sap looks like blood.
2. The leaves are shaped like hearts.
3. Its nectar is very sweet. (Hop _____)
4. Feels like a kitten's toes.
5. Looks like a small dandelion. (clue: young horse's foot)
6. Ontario's flower.
7. It has a hairy stem, leaves at the base and a cluster of flowerheads (weed).
8. Two umbrella-like leaves.
9. We like to eat its sweet red berry. (Wild)
10. A small 5-petaled flower. (_____beauty)
11. Beautiful smelling bell-like flowers. (Clue: valley)
12. You might use it on a hot dog.
13. Many tiny petals. (Daisy _____)
14. These grow on lawns and in fields.
15. This flower closes at noon. (clue: goat)
16. A dark red flower with soft fuzzy leaves. (clue: gingerbread)
17. Do you like butter?
18. Hairy, maple-like leaf with many white flowers on a stalk.
19. A cluster of white, four-petaled flowers with toothed leaves.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Wildflower names used in this puzzle:

clover
toothwort
foamflower
pussytoes
lily of the valley
mayapple
daisy fleabane
blood root
coltsfoot
violet
goatsbeard
dandelion
wild ginger
trillium
hawkweed
spring beauty
buttercup
wild strawberry
mustard

References

Andrews, Terrestrial Ecology, 1974, Prentice-Hall.

Exploring the Environment with the Handicapped. Ministry of the Environment Information Services.

Spring and Summer using the Out-of-Doors, City of North York Outdoor Education Dept.

Science in Action - Woodland and Open Places, McGraw-Hill Ryerson

APPENDIX I

BACKGROUND INFORMATION

a) General

This segment has been included to assist the instructor who has a limited science background to deal with some of the topics of discussion which may arise during this study.

In the following section the vegetation, animal life and physical factors of three communities are compared. These communities are: An old field, a deciduous forest and a coniferous forest. The section should provide some insight into the interactions occurring between the physical factors and the plant and animal communities existing in the area.

1. VEGETATION

a) Vegetation of an old field. In an open area, the organisms present must be able to withstand harsh conditions, such as wind, extremes in temperature, lighting (day and night differences) and periods of flood and drought. In an old field, you will find many kinds of wildflowers. There is sufficient sunlight to provide energy for the plants to grow, produce flowers and release seeds during the short summer period.

Pollination by wind or insects is common in an old field. Colorful flowers and sweet-smelling nectar attract the insects to a plant. Although the insect receives food (nectar and/or pollen) from the flower, the main reason the plant tries to attract insects is for its own survival. In moving from flower to flower, the insect transfers pollen from the stamens of the first flower to the pistil of the second -- thus pollinating or fertilizing the flowers.

Where wind pollination occurs, it is not necessary for the plant to have a colorful flower or smell. Grass is a wind-pollinated plant. Long, protruding stamens bearing an abundant load of pollen facilitates wind pollination. The fine, flexible structure of the grass allows it to bend easily and rub against adjacent plants to transfer the pollen.

The seeds of plants in an old field are usually dispersed by wind or animals. Seeds dispersed by wind are generally very light to increase their distribution over a greater distance (e.g. dandelion seeds). Animal-dispersed seeds usually bear some structure which enables them to cling to an animal (e.g. the hooks on a burr).

Plants in an old field are often subjected to dry conditions and large daily temperature fluctuations. The plants have structures which help to protect them from the abofe factors. For example, many plants have a thick, waxy coating on their leaves or stem to help reduce water loss. Hairs on the leaves and stem also help to reduce water loss by creating a dead air space or insulating layer. (e.g. milkweed). These plants are siad to have adapted to their environment.

Plants of an old field, such as golden rod, fireweek and common mullein, are often termed pioneer species in succession. They are the first species to establish themselves in a recently disturbed site.

b) Deciduous or c) Coniferous Forest

In a deciduous or coniferous forest setting, fewer annual wildflowers will be found than in an old field, as the plants cannot receive sufficient light energy. Instead, perennials are more prominent.

Trees and other forest plants usually flower in the early spring before the leaves of the trees appear. In this way, the forest floor can receive sufficient energy from the sun to support reproduction. The absence of leaves also enables wind pollination to occur. For example, maple tree flowers are out in spring before the leaves. Pollen from the male flowers fertilize the female flowers. By September of that year, the seeds are ready for dispersal.

Seed dispersal is by wind and animals for trees and by animals for smaller forest plants. The seeds of forest plants usually require a longer germination period since they receive less sunlight than seeds of a field plant. Often the forest seeds are larger so they may contain a larger food reserve (e.g. acorns).

Organisms (plant or animal) are very protected from the harsh conditions presented to open field areas.

The forest canopy protects underlying vegetation from large temperature fluctuations and from drying out. Thus, structures to deal with these physical stresses are missing from forest species.

Soil is another physical factor which determines the types of animals and plants found at the site. For example only organisms which are tolerant of an acidic soil can life in a coniferous forest. (Pine needles decompose to form a very acidic soil.)

The cool, shaded forest provides an ideal habitat for moss and fungi growth. Fungi are useful for breaking down dead vegetation to return the nutrients to the soil.

In terms of succession, the final or climax stage of succession is a self-perpetuating forest (e.g. a beech-maple forest in central Ontario).

(Further information can be obtained from Terrestrial Ecology by Andrews.)

II. ANIMAL LIFE

Insects can be found associated with particular plants. The color and structure of a flower may be adapted to attract a particular insect species. For example, red flowers having a flat top would attract butterflies only. The color red is attractive to butterflies and the flat top structure enables the butterfly to perch on the flower to collect nectar. Neither bees nor hummingbirds would visit such flowers. Why? Bees cannot see red, so they would not be attracted to that color of flower. Hummingbirds must hover over a flower while collecting nectar. A flat top flower such as Queen Anne's Lace, would prevent a hummingbird from collecting nectar in this fashion.

Various insect species occupy different habitats. While one species may live close to the ground on a tree, another species may live on the ends of the foliage. Species living in different habitats help reduce competition among themselves for space and food. Occasionally, an animal may occupy the same habitat as another, but will be active at a different time of day (e.g. moths at night, butterflies during the day).

Often the insect species is colored to blend in with the surroundings of its habitat, such as a green grasshopper which blends in with the grass where it is normally found.

An insect's structure is often adapted to its habitat. Organisms such as the earthworm, living in the moist soil of the forest, often have moist skin whereas organisms found in a drier habitat have a thick, hard outer shell, like beetles, to prevent drying out.

III. PHYSICAL FACTORS

Plant and animal communities will differ where the physical factors are different.

In an old field, large daily temperature fluctuations occur. Organisms from an old field are exposed to more light, wind and periods of dessication (drying out) than organisms from a forest. Only plants and animals tolerant of such harsh conditions can grow in an old field.

Soil is another physical factor which will determine whether a plant or animal is found at a site. Soil from a coniferous forest is more acidic than soil from a deciduous forest, due to the decay of the acidic pine needles. Only plant and animal species tolerant of this type of soil can live in a coniferous forest.

From From the Lakes to the Trees, Ministry of the Environment, Information Services Branch.

Field to Forest Succession (Plant Succession)

The process by which one type of vegetation is taken over by another is known as plant succession. Vegetation is always changing.

When an area of land has been cleared, either by nature or man's action, it will not stay barren for long. The first plants must be tolerant of bright sunlight, poor soil nutrients, and other harsh conditions. Plant succession can be traced through several stages, however, there are no distinct steps since it is a continuous process.

A. First Stages - Pioneer Plants

1) Algae, Bacteria and Lichens
These are the first "pioneer plants" to take hold. They can survive where other plants could not. Algae, bacteria and lichens live, then die, and help enrich the soil, preparing it for later stages of succession.

2) Mosses
A more advanced pioneer plant, moss, is soon able to grow. The mosses, along with the earlier pioneers are individually small, however, they are so numerous that the overall effect is large.

3) Grasses and Flowering Plants
As the soil becomes increasingly richer, fast travelling seeds of annual grasses and weeds, such as goldenrod, can now grow in the moss and lichen environment. The grasses and weeds will increase the soil's ability to hold water which is very important in plant growth. After 3 or 4 years, perennial plants begin to grow. This progression helps to add nutrients to the soil and aids the development of future growth. The seeds of these higher plants are constantly drifting in during the early stages, however, due to the difficult conditions, they were unable to survive until the soil and other conditions were right.

B. Shrub Stage

Longer lived plants and improving soil, provide perches for birds who help with seed dispersal. Shrubby trees begin to grow, e.g. cherry, sumac, willow, aspen and conifers (or evergreens). These trees are shade-intolerant (a lot of sun is needed in order to grow and survive).

C. Climax Plants

The young seedlings of the shrub trees cannot get started in the shade of the parent plant. Thus the more shade-tolerant trees have an advantage, e.g. oaks, maples, beeches, and other hardwoods.

Finally a point is reached when the young trees are the same species as the mature trees and no other change of species occurs. This is known as the climax stage (forest climax), the final step in succession.

The area tends to remain in forest climax as long as there is no interference from man. Depending on conditions, this process can be interrupted at any stage.

There are practically no natural succession climax woods left in Ontario.

Plant Succession Activities

A. Soil Study - Compare soils in several areas.

1) Do the soils differ from area to area?

2) Some locations have more organic materials and other spots have more sand and pebbles.
How does this affect the vegetation?
Some plants prefer certain soils and will only grow in that soil.

3) How much water can the soil hold?
Do a soil porosity test.
The results are closely related to the composition of the soil.

B. "Read" the woods - short trees with low horizontal branches, in the woods, indicates that this area could have been an open, old field in the past (recent).

1) What would tall, vertical trees with high branches mean?

2) Is a pine woods older or younger than a forest with many deciduous trees?

3) Look around and observe.

From Spring and Summer Using the Out-of-Doors, North York Board of Education.

For further ideas see "Growing Green - Some Early Experiences with Plants". This booklet is available through your principal from the Material Distribution Centre at Peckham. North York Board of Education.

(c) Niche - a habitat supplying the factors necessary for the existence of an organism or species; the ecological role of an organism in a community esp. in regard to food consumption.

What environmental factors seem to influence the plant's ability to grow in a particular niche (Sun, Temperature, etc.)

APPENDIX II a) Younger Children

Field/Forest Study

A. Physical Characteristics

1. Which area are you looking at? _____
2. Describe your area (shape of the land; open or flat; steep or rolling?)

   _____
3. Is it sunny and hot or shady and cool?

   _____
4. Is it windy or calm? _____
   What direction is the wind blowing? _____
   What is the speed of the wind? _____
5. What is the temperature in the ground? _____
   on the ground? _____
   1 m above ground? _____
6. Is the soil wet, moist or dry? _____
   What is the colour of the soil? _____
   What does the soil smell like? _____

B. Vegetation

1. How many different kinds of plants are there? _____
   Is the width and height of all plants the same? _____
2. Can you find different colours? Name them _____

   _____

   _____
3. Can you find any seeds? How many different kinds? _____
   Where did they come from? _____
4. Are the plants here low growing or creeping or are they bushy and tall?

   _____
5. Can you find any dead (and decaying) plants? _____
   Is this important? Why? _____

   _____
6. Are there any flowers? How many? _____
   What do they smell like? _____
   Why do they have a strong or weak smell? _____

   _____

7. Look at the flowers, stems, trunks and leaves of plants. How do these things help the plant?_____

_____

_____

_____

_____

C. Animal Life

1. Do you see flying insects around certain plants?_____

_____

2. What sounds can you hear?_____

_____

3. What other insects can you find? Draw them.

4. What things tell you animals were there? (hints: worms, ants, spiders, leaves, wood) _____

_____

_____

_____

5. Spread the plants apart, and look closely at the ground. Can you see any: spiders?_____

beetles?_____

snails or slugs?_____

larvae?_____

ants?_____

Appendix II b) Older Children

Field/Forest Study

A. Physical Features

1. Location _____

2. Describe the lay-out of the land (steep, flat, open, sheltered) _____

   _____

   _____

3. What percentage of the day is your quadrant in the sun? _____

4. Record wind speed? _____

   wind direction? _____

   Is this important? _____

   _____

5. Temperature: in ground _____

   on ground _____

   1 m above ground _____

6. Soil: wetness _____

   colour _____

   smell _____

7. How does the site affect vegetation? _____

   _____

   Animal life? _____

   _____

B. Vegetation

1. How many different kinds of plants are there? _____

2. Estimate percentage of the plants present. Make sure you take a bird's eye view.

   moss: _____ trees: _____

   grass: _____ bare ground:

   weeds: _____ _____

   Draw the above into the square provided.

   What is the most common plant/tree type?

   _____

3. Choose the tallest plant/tree and measure its height: _____

   Look at the root system of this plant/tree (use a trowel). How deep does it grow? _____

   (NOTE: estimates of tree sizes may be necessary. The instructor will show you how to do this.)

4. Name the different colours present _____

   _____

5. List any seeds present: How did they get there?:

6. Describe the plants in general (bushy, creeping, short, tall, etc.):

7. Are there dead or decaying plants?
   Why are they important?

8. Why is scent and/or colour important in a flower?

9. List plants/trees found, how the plant protects itself and how man could use them (if possible) and how animals could use them:

Plant/tree	Protection	Man	Animal
e.g. Rose	thorns	gifts	aphids-food
Dandelion	milky sticky sap, long deep root	salads	rabbits - food
Cedar	tough bark	pencils	deer - shelter

C. Animal Life

1. List animals (including insects) that:

run	fly	hop	walk	crawl	climb

2. What sounds can you hear?

3. What animal signs can you find?

APPENDIX III

FIELD/FOREST SUMMARY CHART

	FIELD:	FOREST:
HOME:		
Temperature: at ground:		
1m above ground:		
Wind: direction:		
speed:		
Amount of light:		
Soil:		
PLANTS:		
Number of plants:		
How much:		
moss:		
grass:		
weeds:		
trees:		
bare ground:		
Plant height:		
Root depth:		
ANIMALS:		
Number of different animals:		
Signs of animals:		

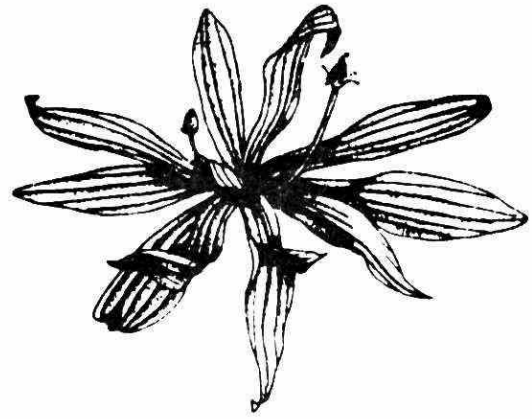
Appendix IV: Common plants and animals

Broadleaf Plantain

Large, smooth, roundish leaves, 3 to 6 inches long. Flower stalks 3 to 6 inches long are easily seen sticking up from the plant's centre. Perennial.

Narrowleaf Plantain/Buckhorn

Long, narrow leaves with parallel veins, 3 to 12 inches in length. Long flower stalks stick up above leaves. Perennial.

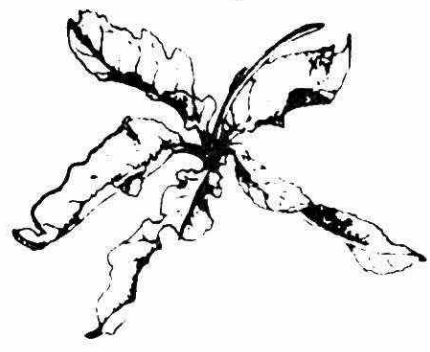


Thistle

Almost stemless, with leaves notched with long spines that hurt if touched at edges. Leaves are spiny and have short hairs and "pimples". Flowers, when present, are purplish. Perennial.

Curly Dock

Almost stemless, with large, reddish-green leaves that are curly and wavy along the edges, growing in a circle around the base of the plant. Flower stalks appear in the centre of the plant and are green or reddish-brown in color. Perennial.



Spurge

Very low growing; stems form circular mats from single root. Stems and leaves are green or often reddish. Positive identification -- pinched leaves yield a milky sap (poisonous). Annual.

English Daisy

Low growing with oval leaves. Flowers stick up. Easy-to-see white or pinkish daisy-like flowers. Perennial.

Clover

Common, non-grassy lawn plant. Three-lobed leaf. Low growing, roots at joints. Flowers white, red, or pink. Perennial.

Burclover

Related to clover. Clover-like leaf. Stems are low growing and spreading. Flowers are small and yellow. Seed pod or "bur" is spiraled and spiny. Annual.

Non-Grass Plants

Chickweed

Slender, much-branched stems with a line of white hairs along one side. Leaves smooth and pointed. Likes it cool. Annual.

Scarlet Pimpernel

Low growing. Stems branched. Most identifiable feature: under a clear sky salmon-colored small flowers are easily seen. Annual.

Dandelion

Almost stemless, with jagged leaves growing in a circle around the base of the plant. Flower stalks rise from the base. Easy-to-see yellow flowers turning into familiar puff-ball seed head. Annual, biennial, or perennial.

Sedge

Very narrow and stiff-leaved plant. Without its flower it looks very grass-like. Unmistakable flower stalk: Little clusters of green flowers growing at the base of six spike-like leaves. Triangular stem, usually taller than lawn. Grows in very wet areas.

Kentucky Bluegrass

Very common and desirable lawn grass. Can be identified in cut stage by looking with a hand lens at veins on upper side of leaf -- look like railroad tracks running down the middle. Will flower along uncut edges of lawn; very tall, from 1 to 2 feet high. Perennial.

Annual Bluegrass

Short, soft, light-green grass. Will continue to form flowers and seeds even under frequent mowing. Usually found in cool, frequently watered areas. Look for light-colored flowers growing on short grass plants in lawn. Annual.

Foxtail/Wild Barley

Occurs as clumps, often in new or infrequently mowed lawns. The leaves are smooth, dull green. The mature seed heads look like a squirrel or fox tail. Often sticking in socks or shoes.

FUNGI

Mushrooms

Many kinds of fungi appear on lawns. Most are in the familiar toadstool shape. Others are button-like. They are usually white or light brown, but can range from bright red, blue, yellow to black. Many are poisonous. Mushrooms do not manufacture their own food, but live off decaying plant material.

Moss

Small, short, soft stemmed plants. Many plants to a patch. No flowers. Found in over-watered lawns. Annual.

Oxtalls/Sourgrass

Looks like clover, but not related. Prefers shade. Grows low with runners. Flowers yellow, small. Stems taste sour. Perennial.

Knotweed/Knotgrass

Very low growing; forms circular mat. Found in areas with lots of foot traffic. Slender, wiry, non-rooting stems. Leaves bluish-green and smooth. Very small white flowers.

Mallow/Cheese Weed

Stems low and spreading. Leaves roundish and broad. Fruit looks like little rounds of cheese. Annual or often a biennial.

Grass Plants

Since grasses are easy to identify when they are in flower, and only weedy grasses usually flower in a regularly mowed lawn, most of the grasses listed are weedy species. Flowers are usually green, brown, or beige.

Crabgrass

Fat leaves, yellowish-green in color, often hairy. Best way to tell is to look at flower. Spreads by seed and runners. Annual.

Bermuda Grass

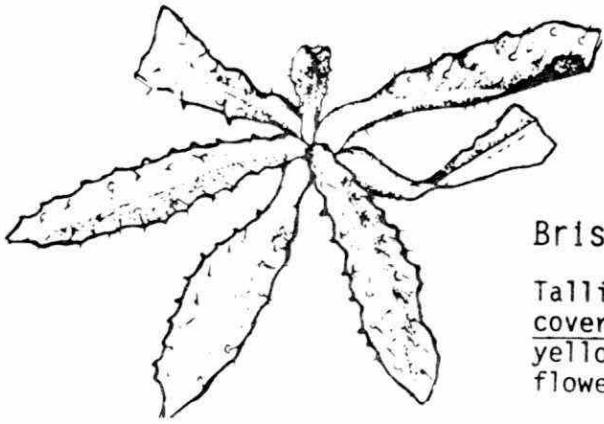
Thick, coarse grass. Stems are smooth and wiry. Runners have many jointed parts with roots at each joint. Flower somewhat similar to crabgrass. Perennial.

Goosegrass

Low, thick mat-forming grass, growing from central point. Appears as a silvery, pale green clump. Will flower even under constant mowing. Distinctive flower. Annual or short-lived perennial.

Ryegrass

Long, narrow leaf, hard to tell from regular lawn grass unless flowering; somewhat glossier than most grasses. Forms clumps. Annual or short-lived perennial.

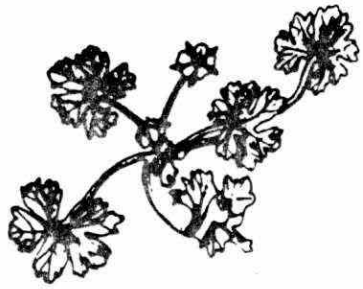


Bristly Oxtongue

Tallish. Coarse, rough-looking plant. Leaves covered with rough hairs and pimples. Flowers are yellow and look somewhat like small dandelion flowers. Biennial.

Dichondra

Low, creeping stems, root frequently at nodes. Can form dense mats, or even "lawns". Leaves lily-pad shaped; 1/4 to 1-1/2 inches in width. Flowers rarely seen. Perennial.



Cutleaf Geranium

Low growing, many branches per plant. Leaves are divided into narrow fingers. Easily seen small purple flowers. Annual.

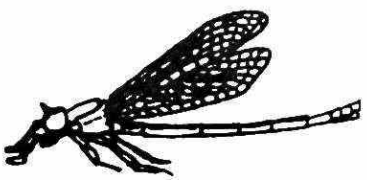
Small Flying Animals

Dragonflies

Brightly-colored, fast-flying insects. Hard to catch. They have four large wings, which are held out when at rest, and a large head. Food: small flying insects.

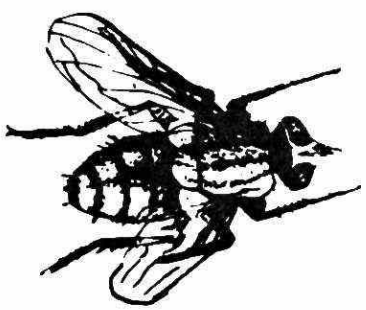
Damselflies

Look like skinny dragonflies. Wings are held close together and point backwards when at rest. They are usually very brightly colored. Food: small flying insects.



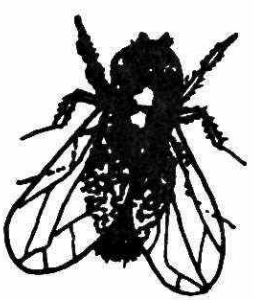
Frit Flies

Small black flies. Usually very numerous. However near lawn surface. Food: larvae feed on grass stems.



Houseflies

Several species of medium-large flies, all of which look something like the common housefly. The location of your lawn will determine the exact species. Stout-bodied, very active; single pair of wings. Food: scavengers on all sorts of decaying vegetable and animal waste matter.

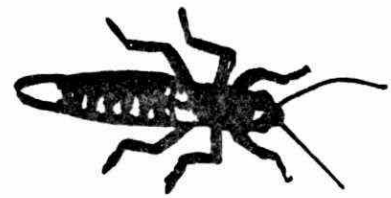


Weevils/Snout Beetles

As their name implies, these are beetle-like in appearance, with the head more or less elongated into a snout. Weevils, like beetles, prefer to run rather than fly. Food: almost all feed on plant material.

Earwigs

Slender, medium-sized insects with large pincers on the end of the abdomen. Earwigs are largely active at night and hide during the day in cracks, crevices, and under objects. Food: mainly scavengers, but also eat live plants.

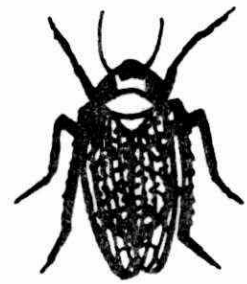


Grasshoppers

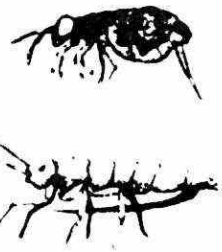
Long-legged, jumping insects. Usually green or brown, they range in size from 1/4 inch to over 3 inches. Very large hind legs to aid in hopping, they also fly. Males sing by rubbing the inside of the hind leg against the lower edge of the front wing. Food: plant feeders.

Leaf Hoppers

Small bugs, very numerous at certain times of year. Oval-shaped body, segments not well separated. Will move sideways, hop, or fly. Often interesting coloration: black, brown and white, or all green, some with red markings. Food: suck plant leaf juices.

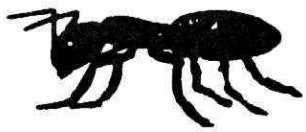


Springtails



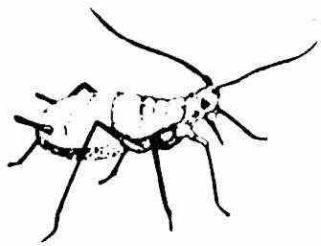
Tiny wingless insects that are very plentiful. They are named after their unique forked tails that they keep folded beneath their body. When disturbed, the tail springs downward, catapulting the insect into the air. May be dark-colored, yellowish, or colorless. Not likely to be caught with nets, but very likely found in traps. Very numerous in the soil. Hand lens is really needed to see them well. Food: scavengers, some feed on microscopic plants.

Ants



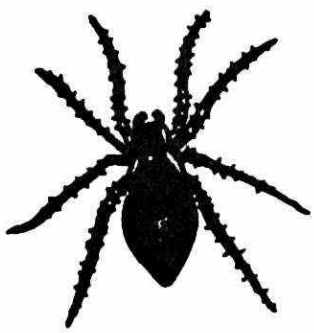
Small, black (sometimes red), narrow-waisted, round-dwelling insects (rarely, winged ones can be found). Often found in large numbers, in swarms or lines. Antennae are usually elbowed. Familiar insect, lives in large colonies. Food: varied; some ants are predators, some herbivores, others scavengers.

Aphids



Small, round, soft-bodied insects. With wings at certain times of year, without wings the rest. Usually green, can be black or brown. With a hand lens, one can see tiny pegs sticking up from rear of abdomen. Food: adults and young suck plant juices.

Spiders



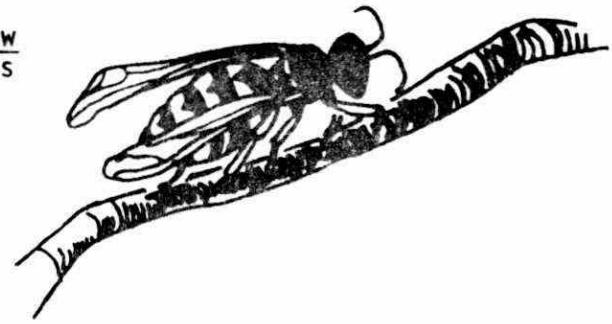
Many kinds of spiders can be found on lawns. All have eight legs, two body segments, and piercing mouth parts. Many spin webs to catch their prey; others, like the wolf spider pictured here, don't have webs but pounce on their victims. Food: all are predators.

Bees

Familiar honey bee with hairy, yellow and black striped abdomen. Usually found near or on clover, dandelion flowers, or other showy non-grass plant flowers. Food: pollen and nectar from flowers, nectar converted into honey back at hive.

Yellow Jackets

Very showy insects with bright black and yellow markings on its non-hairy abdomen. These wasps are pesty and will sting if disturbed. Food: scavengers, very noticeable during picnics.



Small Wasps

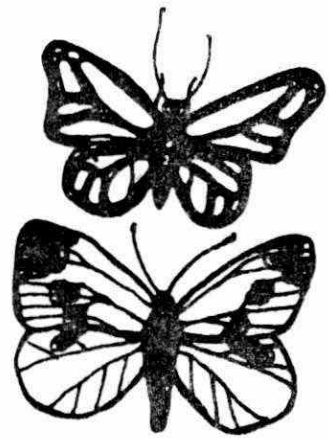
Any of a number of species of small, black, narrow-waisted wasps. Common in small numbers at all times of the year. Food: most are parasitic, laying their eggs into a host insect; the larvae feed on that host from the inside, eventually killing the host.

Butterflies

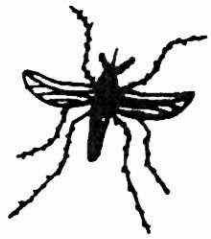
Slender-bodied insects with large, often brightly-colored wings. Wings are covered with tiny scales. Antennae are slender with a swollen knob at the end. Food: adults often don't feed -- if they do, usually on flower nectars; larvae feed constantly on plant material.

Pictured here:

Monarch - black and orange
Cabbage - white and black

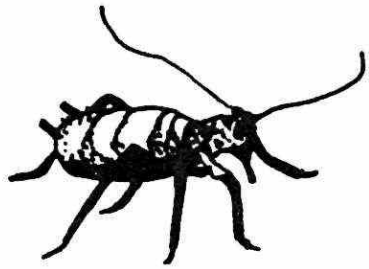


Typical larvae or caterpillar



Mosquitoes

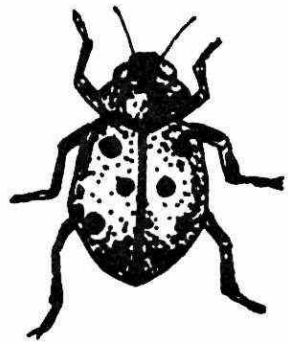
Skinny, long-legged small flies. Only one pair of wings, which are fringed with tiny scales and hairs (a hand lens is needed to see these). Most have long, piercing, sucking mouth parts. Food: females suck blood, males feed on nectar and plant juices.



Aphids

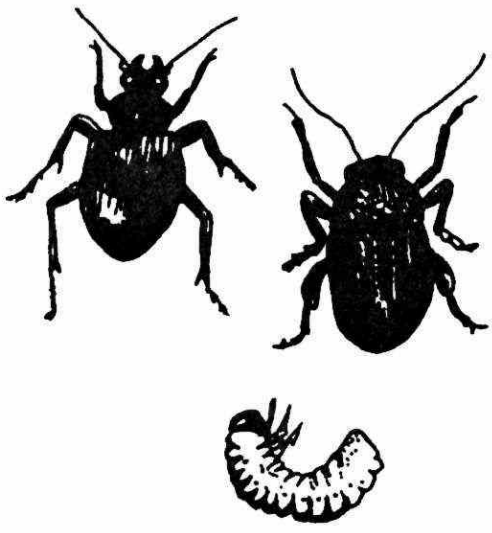
Small, round, soft-bodied insects. With wings at certain times of year, without wings the rest of the year. Usually green, can be black or brown. With a hand lens, can see tiny pegs sticking up from rear of abdomen. Food: adults and young suck plant juices.

Small Non-Flying Animals



Ladybug/Ladybird Beetles

Medium-sized, round, reddish-orange beetles with black spots (or reverse coloring). Often very common. Can be seen crawling to top of a blade of grass, flying a short distance, and repeating the action. Food: both adults and larvae are predators; favorite food is aphids.



Beetles

Many types of beetles can be found on lawns; only the ladybird beetle is common enough to be specifically identified here. Beetles range in size from less than 1/8 inch long to 1 inch long. Pictured here are two kinds likely to turn up. A ground beetle and a flea beetle. Beetles are all hard-bodied and rarely fly. Their wings are folded under their hardened backs. Food: some are predators, others are herbivores, still others are scavengers. Ground beetles are mostly predators, flea beetle adults feed on leaves, and the larvae feed on the roots of plants, particularly dichondra. Larvae often eat different food than adults.

Mites

Tiny spider-like animals; all adults have eight legs. Mites look like fast-moving dots. Colors vary; red, orange, brown, and black are most common. Food: varies; some are predators, others herbivores or scavengers.

Millipedes

Medium-sized, elongated, wormlike animals with many legs. Most millipedes have 30 or more pairs of legs, usually two pairs per segment; Often millipedes can be found rolled up into a ball. Food: most are scavengers.

Centipedes

Medium-sized, elongated, flattened, wormlike animals with 15 or more pairs of legs. Each body segment has a single pair of legs. Very active and fast-running, unlike millipedes. Usually orange in color. Some will bite or sting if held in the hand. Food: predators.

Isopods/Pill Bugs/Sow Bugs

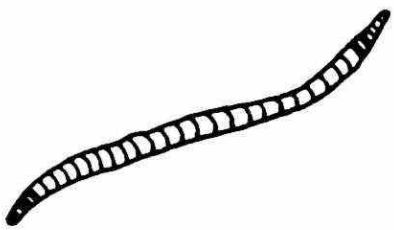
Medium-sized, oval-shaped, armored animals. Brown, black, or grey in color with yellow spots. Legs originate underneath the armored back and often can't be seen from the top. When alarmed, pill bugs roll up into a tight ball, or "pill". They live in cracks, crevices, or even out in the middle of the lawn. Mainly active at night. Food: mainly scavengers, but will eat fresh plant material.

Snails

Soft-bodied animals with a hard, coiled shell. Very small snails can be quite plentiful in lawns, especially ones around 1/16 inch. Food: fresh and decaying plant material.

Slugs

Look like snails without shells. Both snails and slugs travel on a slippery substance that they secrete; they thus leave a track where they have been. Food: fresh and decaying plant material.



Earthworms

Segmented worms with a large band around the body about 1/3 of the distance from the head. Size varies from 1 inch to over 6 inches. Earthworms are very numerous in lawns, frequently come up after the lawn is watered or at night. Food: scavengers; eating material in soil.

From Exploring the Environment with the Handicapped, Ministry of the Environment, Information Services Branch.

ENVIRONMENTAL GAMES

INTRODUCTION

Environmental games are activities that make the children aware of food chains, predators and prey, and the feeling of hunting and being hunted.

OBJECTIVES

(1) Through play acting, children will develop an understanding of plant and animal relationships.

CONCEPTS

(1) Children will learn the meanings of food chains, predators, prey, mating, survival and the importance of balancing population sizes.

PRE-FIELD TRIP PREPARATION

For instructors unfamiliar with outdoor field trips, a reference guide may be suggested. Shirley Brehms' A Teachers Handbook for Study Outside the Classroom (Merrill Pub. Co.) considers all angles of a field trip.

Choosing a Field Site

Before beginning the games, the instructor should decide on a site where the group can do the activities. Because many of the games require that the children be blindfolded, a site should be chosen that is free of potholes or dangerous objects. A large field area is excellent. Some of the games can be played indoors in a gym in the event it should rain.

Clothing and Equipment Required by the Student

1. comfortable walking shoes (boots if bad weather)
2. socks
3. jacket or sweater if cool weather
4. rain gear if unfavourable weather
5. shorts or slacks for all students depending on weather.
6. if possible old clothes should be worn so that if they get dirty, a fuss will not be made

Note: It is stressed that the study is held outdoors unless the weather is so unfavourable that such an endeavour would be detrimental. In this case the study will be replaced by rainy day indoor activities.

Activities Beforehand

Instructors should read all background information (Appendix I).

(1) Teach or review Food Chains / Food Webs.

(2) Teach or review the concepts of adaptation -- adjusting to and accepting without changing the environment.
(e.g. bats have developed a keen hearing system similar to radar to aid them in their hunting at night)

Equipment

Each game has its own equipment list.

FOOD CHAIN GAME (younger children)

Equipment

popcorn
baggies
armbands of two different colours

Explanation (20 campers)

primary producers - popcorn
herbivores - grasshoppers (green armbands) (13 participants)
primary consumers - frogs (blue armbands) (5 participants)
secondary consumers - snakes (2 participants)
(Essentially this game is similar to tag)

(this (ratio (should (be main (tained

Popcorn is scattered over the ground. Grasshoppers are released and are free to graze (collect popcorn in their baggies). The frogs are released after a short interval. They must capture a grasshopper, transferring only the popcorn from the grasshoppers' stomach (bag) into their own.

The frog, when caught by a snake, must hand his popcorn over to the snake's bag.

As a twist, tape markets can be put on the bags at 3 cm. from the bottom for the grasshoppers, 5 cm. for the frogs, and 7 cm. for the snakes. If the popcorn does not fill the bag to the line, then the person starved.

Following the game, discuss:

a) the concept that predators can also be prey, e.g. frog
b) what would happen if we changed the numbers of an animal, e.g. more grasshoppers.
c) food pyramids - have each group hold up his bag at the end of the game.
d) Who would eat the snake? Where does the chain end?
e) energy transfer can be discussed.

Owls and Crows (for younger children)

THIS is an excellent game for reviewing newly-learned concepts. Divide the group into two equal teams, the Owls and the Crows. Line up the two teams facing each other, about two feet apart. About 15 feet behind each team, draw another line for Home Base. The leader makes a statement aloud, and if the statement is true the Owls chase the Crows, trying to catch them before they reach their Home Base. If the statement is false, the Crows chase the Owls. Anyone caught must join the other team.

If the answer isn't obvious to the players, you'll get some of the Owls and Crows running toward each other, and others running back to their Home Bases. During the pandemonium, the leader should remain silent and neutral. When the action has calmed down, he can reveal the correct answer.

Here are some sample statements: Sensory: *"The wind is coming from behind the Crows."* Conceptual: *"A deciduous tree keeps its leaves all year long."* Observational: (after showing them a leaf) *"The leaf had five points and five veins."* Identification: *"This seed comes from an oak tree."*

From Sharing Nature with Children, Joseph Cornell

THE KEY GAME (for younger children)

Equipment

a set of keys or a noisy object
one blindfold

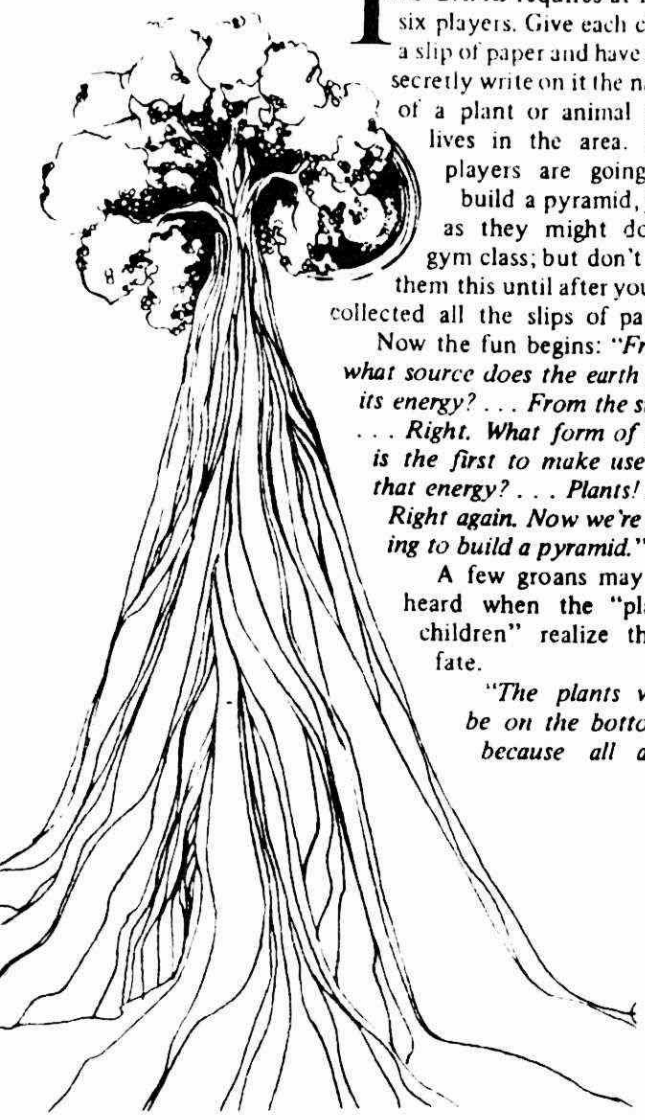
Explanation

The children sit in a circle. One person is selected to be prey and blindfolded. They kneel in the centre of the circle, and the keys (their life) are thrown into the area. The prey must locate their life and guard it between their hands NOT touching the keys themselves.

A predator is selected to try to steal the life from the prey. If he/she is tagged by the prey, they have failed in their attempt. Two new people should replace them.

The importance of sound in nature may be discussed.

Pyramid of Life (for older children)



THIS GAME requires at least six players. Give each child a slip of paper and have him secretly write on it the name of a plant or animal that lives in the area. The players are going to build a pyramid, just as they might do in gym class; but don't tell them this until after you've collected all the slips of paper. Now the fun begins: "*From what source does the earth get its energy? . . . From the sun! . . . Right. What form of life is the first to make use of that energy? . . . Plants! . . . Right again. Now we're going to build a pyramid.*"

A few groans may be heard when the "plant children" realize their fate.

"*The plants will be on the bottom, because all animals depend on them directly or indirectly for food. All the plants kneel down here on all fours, close together in a line. Now, as I read off the animals from the slips of paper, tell me whether they are plant-eaters or meat-eaters. All the plant-eaters (herbivores) stand in a line behind the plants. All the meat-eaters (carnivores) stand in another line behind the herbivores.*"

There will nearly always be more children in the upper-level groups than in the supporting plant levels; it's a lot more fun to be a bear or mountain lion than it is to be a dandelion or a muskrat. Humility, alas, seldom stimulates the imagination. With so many tops and so few bottoms, it will be impossible to build a stable pyramid. Some of the predators will just have to forfeit their exalted status. Challenge the children to reconstruct their own pyramid into one that will easily support all its members. (Tell them the bigger children can change to plants if they wish.) Clearly, the higher up in the food chain, the fewer the number of animals there are. Demonstrate the importance of plants by pretending to pull one of them out of the pyramid.

From Sharing Nature with Children, Joseph Cornell

Animal Parts (for older children)

THIS GAME is for groups of four or five children. Ask each group to select an animal common to the area. Then tell them that each group will have to imitate the body of their animal. They are going to appear before an "animal expert" or "panel of experts" who will try to guess their identity on the basis of the movements and behavior they act out. No noise is allowed, except what they can make with props (optional) such as a tin can with rocks in it to mimic the rattle of a rattlesnake.

Give the groups about five minutes to work on their acts: *"Oh, no! A scorpion has eight legs – we'll* all *have to be legs! . . . I can be the head, too, since I'm up front and my arms can be the pincers. . . . Okay, I'll be the tail, but I don't think I can hold it too long. You guys will have to bend forward and hold onto each other to make the body. Ready?"*

Webbing (for older children)

HERE IS A GAME that makes very clear the essential interrelationships among all the members of nature's community. Webbing vividly portrays how air, rocks, plants, and animals function together in a balanced web of life.

The children form a circle. The leader stands inside the circle near the edge, with a ball of string: *"Who can name a plant that grows in this area? . . . Brodiaea . . . Good. Here, Miss Brodiaea, you hold the end of the string. Is there an animal living around here that might eat the brodiaea? . . . Rabbits! . . . Ah, a sumptuous meal. Mr. Rabbit, you take hold of the string here; you are connected to Miss Brodiaea by your dependence on her flowers for your lunch. Now, who needs Mr. Rabbit for his lunch?"*

Continue connecting the children with string as their relationships to the rest of the group emerge. Bring in new elements and considerations, such as other animals, soil, water and so on, until the entire circle of children is strung together in a symbol of the web of life. You have created your own ecosystem.

To demonstrate how each individual is important to the whole community, take away by some plausible means one member of the web. For example, a fire or a logger kills a tree. When the tree falls, it tugs on the strings it holds; anyone who feels a tug in his string is in some way affected by the death of the tree. Now everyone who felt a tug from the tree gives a tug. The process continues until every individual is shown to be affected by the destruction of the tree.

From Sharing Nature with Children, Joseph Cornell

STALKING (older children)

Equipment

- several twigs
- blindfolds

Explanation

Each participant has a partner. One person is blindfolded (the prey), led onto the playing field and left standing, feet apart slightly. A marker or twig is then placed between their feet. This is their life. The other participants (predators) then return to the home base.

On signal, the predators are to stalk any of the prey to try to "steal" their life (the twig). If, however, the prey hears the predators' movement, hence are alerted, they point in the direction and thereby send the predators back to the starting point. The predators may then begin again. "Radar sweeping" is not considered fair (i.e. the prey sweeping their arms all over the area to eliminate predators).

Silence is important in this game. Even when the prey's life has been taken no sound should be made, the game merely continued until all the lives have been taken. Hunting in packs is completely permissible.

The people then switch positions, predators become prey and vice versa.

This game can also be played in a cleared forest area free of poison ivy or dangerous objects. Care should also be taken for the game to be played in an area where human interference (trains, planes, factories, etc.) will not mask the natural noises.

The participants will become more attuned to their own sounds as well as listening more intently outdoors.

ECO-ACT (older children)

Equipment

Eco-Act cards - the instructor can construct their own set from the sample following.

Explanation

Put all of the cards into a box. Select a child to come up and draw a card. The child then chooses another person to act out the situation. A discussion can follow.

YOU: An environmentally-minded person
SITUATION: A controversy has erupted in your area over the merchandising of soft drinks in non-returnable plastic bottles. As an environmentally-minded person, you are opposed to the idea. However, at a meeting a local soft drink bottler opposes you. She claims that the plastic bottles are cheaper and hold down costs, like the energy used to transport them (plastic bottles are light) and the cost to stores and bottlers in handling returnable bottles. Now you must respond to her argument and convince those attending this public meeting!
OTHER PERSON: A local soft drink bottler

YOU: Rose a well-heeled shopper
SITUATION: This morning you are shopping with your 16-year-old daughter, Susan. One of your stops involves Pierre's Furs, where you need to try on fur stoles. Your husband even suggested that you might buy Susan a winter coat with a fur collar. However, as you walk toward the store, Susan suddenly becomes aware of where you are going and your purpose in going there. She is stunned! She wants to know why you want to drape your body with the the remains of dead animals, why you thought she might want to do the same, and how you can participate in such a gross economic exploitation. She has stopped in her tracks and looks at you --- right there in the middle of the sidewalk!
OTHER PERSON: Susan, your daughter

YOU: A happy homeowner
SITUATION: Pride in homeownership has always been one of your virtues. You keep your suburban home well painted and maintained, but you take special pride in your lawn. The plantings are exquisite! The lawn is a deep, lush green. This spring as you are caring for the lawn and applying your normal round of fertilizer, a neighbour stops you. She is very emotional about the use of fertilizer and the subsequent run off into the pond at the end of your street. After chewing you out, she pauses awaiting your response.

OTHER PERSON: Ms. Vita , a neighbour

SURVIVAL GAME (for older children)

Developed and adapted from a game by Frank Glew,
Waterloo County Board of Education.

Purpose: To increase awareness and appreciation of the environment.

Object: To role play a specific animal in an ecosystem and "survive".

No. Participants: 15 - 40.

Equipment:

1. Storage and data board
2. Life tags - colour coded and marked with animal's name
   12 required by each herbivore except deer and moose
   4 required by every other animal
   stored on shower rings hung on "extras" row on data board
3. Shower rings - one per player
4. Food and water stations - yellow and blue boards marked with "Food" or "Water" and equipped with an orienteering punch for identification
5. Food and water cards - blank cards which can be punched for identification
6. Headbands - coded for the various animal types
   Herbivores - green
   Omnivores - red
   Carnivores - yellow
   Disease - black
   Elements - white

Area: 2-3 acres of field, bush and stream with well-defined boundaries
- food and water stations placed throughout game area between one and two feet above the ground
- two points of entry are needed, one for males and one for females

Each person is assigned an animal which he will represent in the game. He should be given the appropriate headband and life tags, as well as a blank food/water card on which should go the person's name and the name of the animal. It is then helpful to seat the group in the food pyramid as outlined in the diagram. This will help visualize predator-prey relationships later on. No animal may kill an animal that is not below it on the pyramid.

(eg wolf/fox - no, wolf/weasel - yes, wolf/mouse - yes)

Herbivores The herbivores are told that survival is dependent on finding as many food and water stations as possible. Each station is coded with a different marker and the herbivore simply punches his blank food/water card at as many different stations as he can find. He may visit each station only once during the game. Survival

is also dependant on not becoming food for carnivores or omnivores or dying at the hands of elements or disease. Deer and moose, although herbivores, have fewer natural predators than most. They may be killed by wolves only and so they have correspondingly fewer life tags.

Omnivores — Omnivores have food/water cards and may visit as many food and water stations as they find. They may also take food by "eating" herbivores. Upon catching a herbivore by tagging, the omnivore takes one of the herbivore's life tags, puts it on his shower ring, and then moves on. Survival is also dependant on not becoming food for carnivores or dying at the hands of elements or disease.

Carnivores — Carnivores have food/water cards and should visit as many water stations as they find. They may take food by catching either herbivores or omnivores. Their survival also depends on their not dying at the hands of the elements or disease.

* All predators (carnivores and omnivores) must survive on their own life tags only. They may not use those of their prey.

Elements and Disease — The elements (hurricane, lightning) and the diseases (rabies and cancer) tag and recover lives from any animal in the game. They have no predator to fear. See additional notes below for playing with rabies as a communicable disease.

Man — The final threat to an animal's life is man. When man enters the game (5 to 10 minutes before its conclusion) word is passed among the animals for man only has to see the animal to win a life tag. Diseases and elements may continue to take lives as well. If killed by man, the animal must give up his life tag immediately and then may attempt to escape. Man's whims may make this impossible. Man may simply send the animal out of the game demonstrating his power even more dramatically.

Tag Exchange:

Killing of an animal is simulated by tagging him and recovering a life tag from his shower ring. The tag is placed on the predator's ring. A predator may not catch the same herbivore twice consecutively. Predators may cooperate on a kill, but only one life tag is taken. A second predator happening upon a recent kill must give the prey a reasonable chance to escape but may attack the other (first) predator immediately. If the first predator flees, then the second predator may claim a life tag from the prey.

Reproduction:

A symbolic mating may be simulated. Have each animal pair exchange life tags with one another before beginning the game. The males (with female tags) are started in one part of the playing area and the females (with male tags) are started in another part of the playing area. Before they may begin searching for food they must relocate their mate and obtain their own tags. A mating call (no words or whistles) which is made up beforehand is the only sound that may be used.

Capture Before Reproduction

If an animal is unable to locate his mate or is captured before finding his mate, then he must return to the start area, wait for his mate, and then restart with only one half his normal number of life tags. This represents a realistic reduction in population if an animal is killed before finding a mate.

Rabies as a Communicable Disease

Rabies can be traced through an animal ecosystem in the following manner. Each animal is given a black tag with his name on it to carry on his shower ring. If captured by "rabies" he gives up a life tag as usual. If he is captured by a predator after this, he gives up a life tag as usual but also hands over his black tag to simulate the passage of that disease amongst animals.

To Play

1. Ensure that each animal has a headband, life tags and a food/water card.
2. Define boundaries clearly.
3. Collect all males together near their entry point and all females near theirs.
4. Send off herbivores first.
5. At full five minute intervals, send off omnivores, carnivores, disease and the elements.
6. After another half hour to forty-five minutes, Man enters the game. The game should be ended five to ten minutes later.

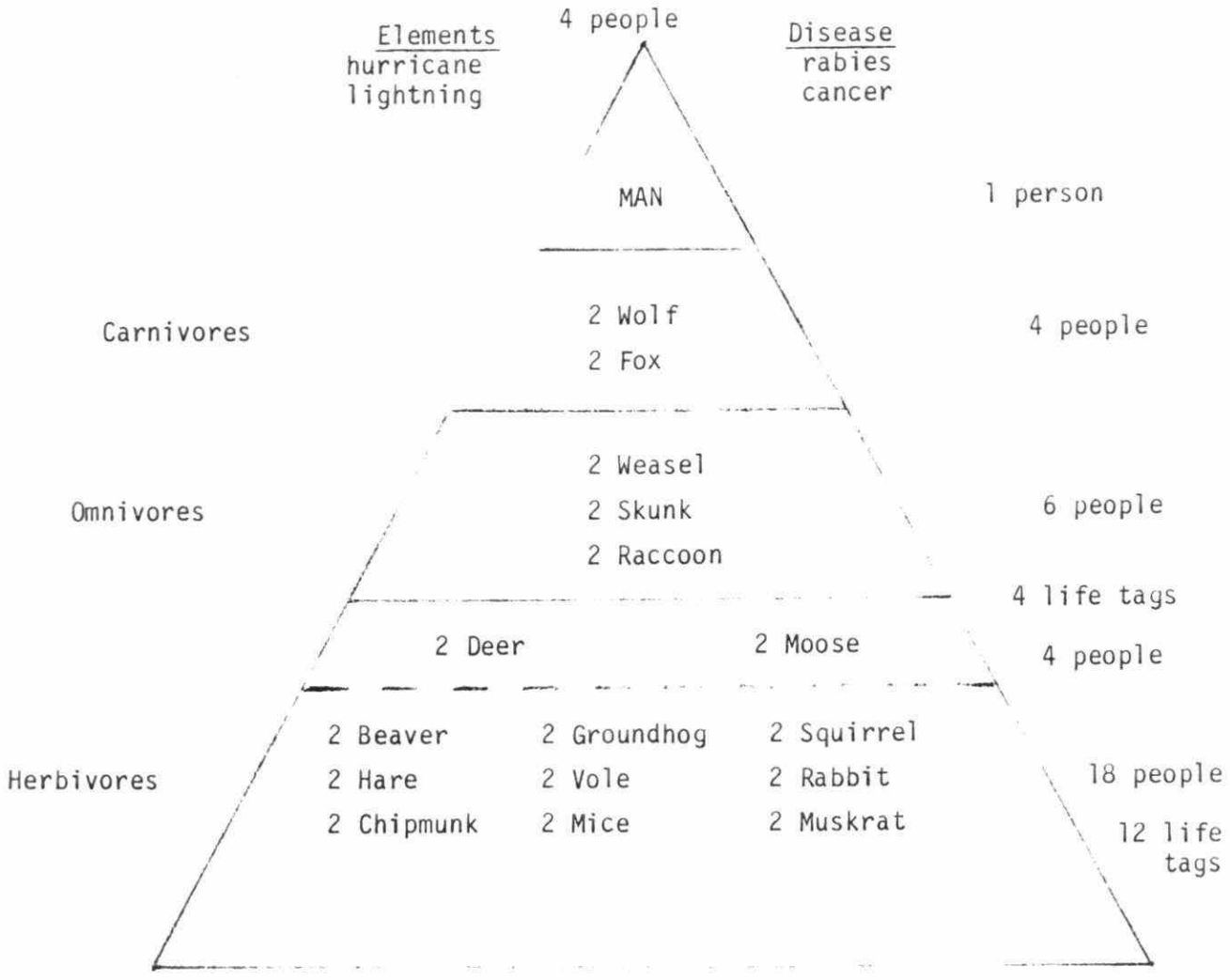
Follow-Up

Extra tags from each herbivore should be hung on the hook from which they were obtained. Each predator then removes all tags he captured and hangs them along the row with his name, under the appropriate column. (i.e. m Wolf hangs a captured f Mouse in m Wolf row and f Mouse column.) Then the carnivore hangs his remaining life tags on his hook in the "extras" row. When all tags are hung then discussion can begin. (See follow-up sheet).

Data from board: How many were killed by natural predators?
disease?
man?
How did this animal play the game?
What would happen if there were more carnivores? More herbivores? More men?

Add your own questions to stimulate discussion.

Food Pyramid



1	man
4	elements/disease
4	carnivores
6	omnivores
22	herbivores
37	participants

SURVIVAL GAME FOLLOW-UP

1. What animal were you?_____
2. How many times were you killed?_____i.e. how many lifetags did you lose.?
3. How much food did you find (food stations and/or animal food)?

   _____
4. How many water stations did you find?_____
5. Where did you get caught the most?
   a) the field
   b) hunting
   c) at a food or water station
   d) in a hiding spot
6. Which strategy did you try most often?
   a) hiding
   b) hunting
   c) an equal portion of hiding and hunting
7. Which feelings did you experience most often? Check two.
   a) fear b) caution c) frustration d) happiness
   e) secretiveness
8. What happened when man entered the game? You:
   a) hid
   b) continued to look for food and water as before
   c) hid first then continued as before
   d) looked to warn a friend
9. What do the above answers tell you...
   a) about being an animal_____
   b) about your success at pretending you are an animal?_____

   _____
10. From those things you have learned by playing this game and answering the above questions, what suggestions could you make in order for animal communities to survive unharmed?

    _____

    _____

    _____

    _____

    _____

    _____

SOUND-OFF (for all ages)

Equipment

Several pairs of noisemakers (e.g. beads in a bottle, kazoos, etc.)
Blindfolds

Explanation

The children are blindfolded and scattered in a roped off area. Each child is given a noisemaker and instructed to find their partner (mate) who is making the same noise. Their noises should be made all the time. Every child should be aware of the predators noise and instructed to AVOID it. If they are caught by the predator, they are eliminated.

As an extra twist, they prey may make their noise only while stationary and the predators while they are moving.

Following the game, discuss:

a) feeling of being hunted
b) reason for being blindfolded - can't see predator - must rely on other senses
c) define predator and prey.

WHO AM I? (all ages)

Equipment

cards with animal pictures

Explanation

Pin the card to a child's back. They may only ask each person one question requiring a "yes" or "no" or "maybe" answer to find out what animal they are.

e.g. a) Do I live in the water?
b) Am I yellow in colour?
c) Do I fly?
d) Do I have 6 legs?

(for all ages)

SCAVENGER HUNTS are probably familiar to you from your own childhood. This one is adapted to finding natural objects. You should assign scavenger lists that require the child to think creatively or to look very closely. Given here is a scavenger list adapted from the one used at the Glen Helen Outdoor Education Center in Yellow Springs, Ohio.

Scavenger Hunt

**17. Everything in nature has a function. *21. Everything in nature is important (even poison oak is important to the birds that eat its berries). *24. A sun trap is anything that captures the sun's heat (water, rocks, plants, animals).*

eg:

Scavenger List

Collect only things that you can return safely and without damage.

1. A feather
2. One seed dispersed by the wind
3. Exactly 100 of something
4. A maple leaf
5. A thorn
6. A bone
7. Three different kinds of seeds
8. One camouflaged animal or insect
9. Something round
10. Part of an egg
11. Something fuzzy
12. Something sharp
13. A piece of fur
14. Five pieces of man-made litter
15. Something particularly strange
16. Something beautiful
17. Something that is of no use in nature*
18. A chewed leaf. (Eaten by what?)
19. Something that makes a noise
20. Something white
21. Something important in nature*
22. Something that reminds you of yourself
23. Something soft
24. A sun trap*
25. A big smile

From Sharing Nature with Children, Joseph Cornell

Bat and Moth (for all ages)

HAVE the group form a circle 10-15 feet across. Choose a member of the circle to be the bat, then have him come to the center of the circle to be blindfolded. Designate three to five other children as moths and ask them also to come to the center of the circle. The bat tries to catch the moths.

Whenever the bat calls out *"Bat!"* the moths call back *"Moth!"* Tell the moths: *"Every time you hear the bat call out 'Bat!' it's his radar signal hitting you. He sends it out to see if there's anything out there. His cry bounces off you and returns to him like a radar signal. The return signal is the word 'Moth!' that you shout. Now he knows moths are near - and he's ready to eat!"*

The bat tracks down and tags the moths by listening to their responses. It takes good concentration to be a successful bat. So this game is good for developing concentration, especially when the bat must chase several moths at the same time.

Add some excitement by bringing two bats into the circle at once. Encourage the bats to hunt as a team. I usually choose a tall bat and a short one, so they won't bang heads if they bump into each other.

From Sharing Nature with Children, Joseph Cornell

Follow-Up Activities

For Younger Children

(1) Draw pictures, write stories, produce plays about the games played.
(2) Play more of the environmental games.
(3) Read and try the games in Sharing Nature with Children (Joseph Cornell - Ananda Pub. 1979).

For Older Children

(1) When get a quiet moment, discuss what would happen to a local watershed if one or more of the food chains were disrupted.
(2) Have a panel debate, class play, etc. on how destruction of the food chain (or web) affects the quality of life.
(3) Other games can be found in various handbooks. A good one is Sharing Nature with Children (Joseph Cornell - Ananda Pub. 1979).

All Ages

(1) After each game played, discuss the ecological principles involved. This should not be too long however, as throwing out copious amounts of information will hinder learning rather than enhance it.

References

Wm. Andrews, Terrestrial Ecology, 1974, Prentice-Hall.
Joseph Cornell, Sharing Nature with Children, 1979, Ananda Pub.

APPENDIX I

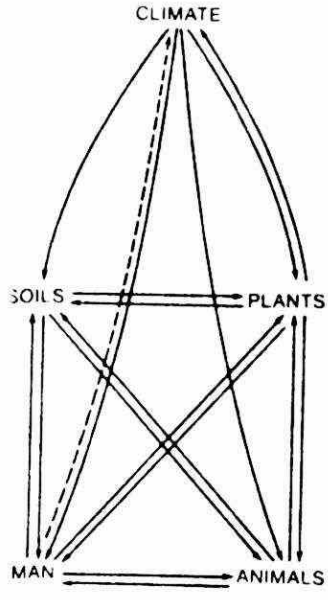


Fig. 1-1
An ecosystem is a complex network of abiotic and biotic factors in which each factor is affected by the others.

1.1 AN INTRODUCTION TO THE ECOSYSTEM CONCEPT

This section provides an overview of one of the most important concepts of science, the ecosystem concept. Read it carefully, since it is the base upon which you will build your understanding of the complex but exciting interactions that occur in terrestrial ecosystems.

A naturally occurring group of organisms (plants, animals, and protists) living in a particular habitat, depending on and sustaining each other, is termed a *biotic* (living) *community*. Such a community cannot exist in a vacuum. It is influenced by and dependent upon *abiotic* (non-living) *factors* such as sunlight, soil, topography, wind, temperature, moisture, and minerals. The interaction of biotic and abiotic factors creates what is called an *ecosystem*. A forest is an ecosystem as is a pond, a meadow, or a classroom terrarium. So intricately knit is the web of interacting factors within an ecosystem that should one vital strand be broken, the ecosystem may be destroyed. A simplified diagram of the interacting biotic and abiotic factors is illustrated in Figure 1-1.

Consider how complex an ecosystem must be that has hundreds of different plant and animal species! Suppose, for example, that a lumber company completely strips a forested area of its large trees. What effects will this have on the forest ecosystem? The trees will no longer add humus to the soil since they will no longer be dropping leaves onto the ground. Snails, slugs, earthworms, and other animals that thrive in the leaf litter will decrease in numbers and, perhaps, vanish completely. Animals that prey on these organisms will be affected. Soil erosion may occur since the leaf canopy is no longer present to absorb the energy of a heavy rainfall. If the soil erodes, many plant species will disappear. The animals that eat these plants will move away or die of starvation. Plants like mushrooms and ferns that require abundant shade and moisture will likely die. Broad-leafed plants like Jack-in-the-pulpit, trillium, and Mayapple cannot live in direct sunlight. Thus they too will be affected.

On the positive side, many species of plants that require intense sunlight will now be able to grow in the area. Grasses, goldenrod, and other sun-tolerant plants will gradually become established. Shrubs and tree species that could not grow in the shade of the forest will appear. New insect populations will be established, and new bird and mammal species will make their homes there. But the original ecosystem is gone, perhaps forever.

The chain of events that occurs when one factor in an ecosystem is altered is long and involved. But it is certain to occur. Try now to imagine further changes that would occur in the forest that has been lumbered. Do you think that neighboring ecosystems will be affected? Would a nearby stream, pond, or meadow experience any changes as a result of lumbering in the forest?

You may feel that lumbering is a poor example for showing how ecosystems change. After all, most of us live a long way from a forest. But think again! How much of Canada and the United States was once forest? Most of you can assume that deer and bear once walked through forests where your school is now located. In fact, the very spot where you are sitting may once have been a secluded forest nook where a

deer fawn found refuge beneath the boughs of a tree. How things have changed! And, every day, still more natural terrestrial habitats are bulldozed to make room for new homes, shopping plazas, schools, and roads. Where will it all end? Can anyone predict the long-term effects of these changes?

The answer to the last question is "Yes." Ecologists have sufficient knowledge of the structure and functioning of ecosystems to predict disasters like soil erosion, depletion of soil minerals on farmland, and flooding due to poor land management. Yet these things still happen. Why? Perhaps it is because the rest of us know so little about the structure and functioning of ecosystems that we fail to understand their advice. Instead, in our relentless pursuit of the dollar, we press on with our "development" of the countryside. Perhaps it is time that we stopped. But that is a judgment which you can make after you have studied the structure and functioning of ecosystems. These topics are surveyed briefly in this section and then dealt with in greater depth in later sections of this Unit.

The structure of ecosystems. Let us first consider the basic similarities in the biotic structure of ecosystems. In any ecosystem there is a continual demand for energy—the plants, animals, and protists require energy to sustain life processes. The sun supplies this energy as light. The *producers* (green plants) of the ecosystem use the light energy to form high-energy organic compounds such as glucose from the basic inorganic compounds, water and carbon dioxide. The process by which they do this is called *photosynthesis* (*photo* means "light" and *synthesis* means "putting together"). The high-energy compounds formed by the producers are used by them for their growth and metabolism. As a result, producers are called *autotrophic* (self-feeding) organisms.

Ecosystems also have *heterotrophic* (other-feeding) organisms. These are known as *consumers* since they are animals which eat plants or other animals to obtain their nourishment. Those animals which eat plants are called *herbivores* (plant-eaters). They are also called *first-order consumers* since they obtain their energy requirements by feeding directly on the producers. Deer and rabbits are herbivores. Animals which eat other animals are called *carnivores* (flesh-eaters). Those carnivores which feed on herbivores are called *first-order carnivores* or *second-order consumers*. The wolf and fox are first-order carnivores. Note that, indirectly, they too obtain their energy from producers. *Third-order consumers* (*second-order carnivores*) are also present in many ecosystems. What are some third-order consumers? Ecosystems also have what is called a top carnivore. What do you think is meant by that term?

Clover is food for the rabbit. The rabbit, in turn, is food for the fox. This statement can be summarized in the following way:

Clover → Rabbit → Fox

This is called a *food chain*. However, most animals have several sources of food. Food chains, then, are not really distinct but interconnect to form a *food web*. Each species—clover, rabbit, and fox—has a function or *niche* in the food chain. In this case, the niches are, respectively, producer, herbivore, and carnivore. It is rather obvious that some species do not have one particular niche in the food web but may have many. The fox may be a carnivore when it feeds on a rabbit, but is a herbivore when it eats berries. Such a complex pattern as the food web is only one of the highly integrated relationships that occur among the organisms of an ecosystem.

Another group of organisms common to all ecosystems are the *decomposers*. They are specialized consumers which feed on dead organic matter, returning basic substances such as minerals and water to the soil. Most decomposers are microscopic organisms like bacteria and yeast. But snails and many fungi are also decomposers.

Producers, consumers, and decomposers are the necessary biological parts of any ecosystem (Fig. 1-2). However, in each ecosystem these roles may be carried out by quite different organisms. See if you can name producers, consumers, and decomposers for each of these ecosystems: a forest, a meadow, a pond, a swamp. Other differences in the biotic structure of ecosystems include population numbers, population distribution, and population growth.

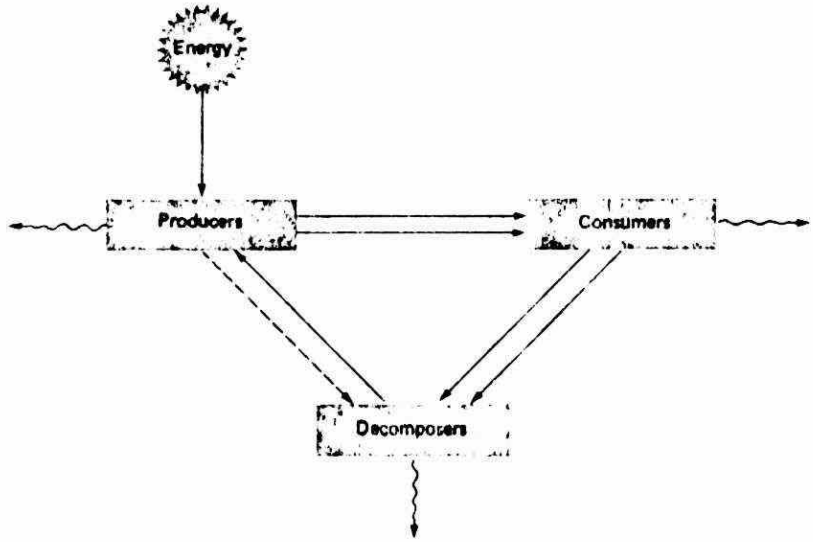


Fig. 1-2
The four basic parts of an ecosystem are a source of energy, the producers, the consumers, and the decomposers. The green arrows indicate energy flow; the wavy lines represent energy lost at each level. The black lines indicate the flow of nutrients. What is the meaning of the broken green arrow?

Now, let us consider briefly the abiotic structure of ecosystems. Basically all ecosystems require the same nutrients—the elements carbon, nitrogen, oxygen, and hydrogen. Also, all ecosystems are regulated by physical factors such as temperature, moisture, light, wind, and nature of the soil. However, all ecosystems have different limits for each of these factors. How these factors vary and how the organisms of each ecosystem are adapted to them is another aspect to be studied in the structure of an ecosystem.

The functioning of ecosystems. No ecosystem is static. Energy and nutrients are flowing continuously through the ecosystem. The functioning of the ecosystem is measured by the rates of energy flow and nutrient cycling. However, it is not easy to measure such rates. In fact, the study of the functioning of ecosystems has lagged behind the study of their structure because of this problem. Therefore your study of the functioning of ecosystems will generally be descriptive, rather than quantitative. For example, you will not measure the rate of energy flow, but you will study the direction of energy flow.

From Terrestrial Ecology, Wm. Andrews.

AQUATIC HABITAT STUDY

INTRODUCTION

In this activity campers are put in contact with an aquatic environment. By exploring an area of a pond or stream for plant and animal life, and by looking at the physical setting, individuals are made aware of the interrelationships that exist among these components.

OBJECTIVES

(1) To develop a better understanding and appreciation of an aquatic environment.
(2) To develop skills in sampling for animals and plants, measuring water velocity, temperature, etc.
(3) To develop identification skills.

CONCEPTS

(1) Animals and plants can be found in almost any body of fresh water, whether it is temporary or permanent, large or small.
(2) Some animals and plants are so tiny that we must use magnifying instruments to see them.
(3) The community that we live in has many different people -- doctors, teachers, street cleaners, and truck drivers. It also has many different types of buildings -- schools, stores, hospitals, and our homes. We need food and shelter in order to survive. Similarly, the community that we are going to study has many different animals and plants. They are suited to their community to obtain their basic life needs -- food and shelter.

PRE-FIELD TRIP PREPARATIONS

Instructors that are unfamiliar with field trips should review A Teacher's Handbook for Study Outside the Classroom by Shirley Brehm (Merrill Pub. Co.).

Choosing a Field Site

Prior to beginning the field activities, the instructor should decide on the site where the group will carry out its investigations. Because the degree of water movement has much to do with the kinds of plants and animals found, there should ideally be a slow flowing "pool" site and a fast flowing "riffle" site. The campers will need to wade in the water. Therefore, the stream should not be so fast and deep that it presents a danger to the campers. Old running shoes should be worn in the water to eliminate the danger of sharp objects puncturing the skin.

Several areas are required for sampling. Silty bottoms render interesting aquatic organisms.

A site that has an overly muddy bottom tends to become murky when campers work in it and poor samples are usually obtained. A slightly stony and pebbly bottom is also a good choice. An ideal stream is anywhere from 3 m to 12 m wide and no deeper than 1 m.

The length of this study will depend on how many parameters of the aquatic habitat you choose to examine. An hour-long session in the field, supplemented with hour-long preparation and follow-up session, is the minimum amount of time you should plan on using. Participants' enthusiasm in the field runs high and it is often difficult to maintain a time limit on this activity.

Clothing and Equipment Required by the Student

(1) One pair of comfortable walking shoes and one pair of shoes that can be worn into the water for protection.
(2) Socks -- these will probably get wet.
(3) Jacket or sweater if cool weather.
(4) Rain gear if unfavourable weather.
(5) Shorts or slacks for all students depending on weather.
(6) Pen and clipboard.

NOTE: It is stressed that the study is held outdoors, unless the weather is so unfavourable that such an endeavour would be detrimental. In this case the study will be replaced by rainy day indoor activities.

Activities Beforehand

Instructors should familiarize themselves with the background material given in Appendix I.

Younger children

(1) Read several stories about ponds or lakes aloud to children. Attempt to draw forth stories about occurrences which have happened to children in or around streams and ponds. What did they see or hear?

(2) With flannel board or bulletin board, make a representative picture of a pond. Using pictures cut out of magazines as examples, discuss what should or shouldn't be placed in the "pond picture".

(3) Water safety rules should be introduced or re-learned.

(4) Appreciation of the environment should be stressed. (see **)

Older children

(1) List the participants' definitions of a stream. These will vary greatly, some including the banks, the bed etc. The concept that the stream is an entire community which includes the plants and animals in and around the stream as well as the water bed and banks should be illustrated.

(2) Water safety rules should be reviewed.

(3) Appreciation of the environment should be stressed. (see **)

**NOTE:

It should be stressed to the boys and girls that they are only guests in the aquatic community and, therefore, they should return all specimens to the water as close as possible to where they found them. Overturned rocks should be replaced in the same position, and plants that are removed should be pulled up with the roots intact and replanted when observations are made.

Equipment Required

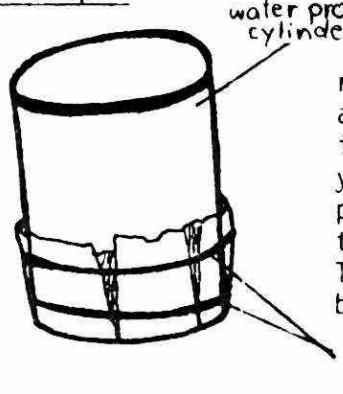
(1) Plastic pails with handles (optional): Ice-cream, frozen fruit, or honey containers are ideal. One for each team.

(2) Sorting trays: White or light coloured dishpans are the best choice, shallow aluminum foil baking dishes such as TV dinner containers or pie plates may be used. Aquatic organisms show up well against a white background so if aluminum containers are used, the bottoms should be painted white, or cut heavy white cardboard to fit inside the container. One for each team.

(3) Magnifying lenses: one for each team at least.

(4) Waterscopes: (optional) May be made from heavy cardboard cylinders about a half a metre in length. Mailing tubes, stove pipes, poster or paper containers are ideal. If cardboard cylinders are used they will need to be waterproofed with polyurethane or a plastic varnish. A bottomless bucket is also useful. Cellophane or clear plastic is needed to fit over one end of the tube.

Waterscopes



Several coats of plastic varnish will be needed to waterproof cardboard cylinders, if they are used. When applying the varnish brush it up into the inside surface of the cylinder as far as you can reach with the brush. Cut the sheet of plastic so that when it is placed over the end of the tube it will extend 5 or 6 cm. up the side. This can be kept tight and secure with elastic bands.

The waterscope may be used to look at the tiny animal and plant life on the stream bottom as it exists naturally. The pressure of the water causes the plastic to become a convex lense so that plants and animals appear larger than they really are.

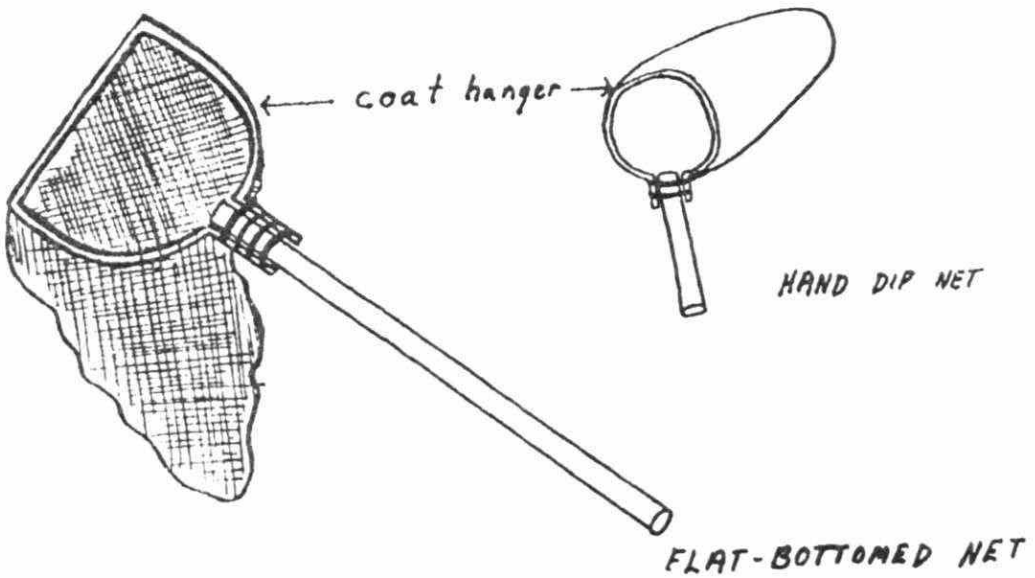
The success of viewing through the waterscope will depend on the brightness of the overhead sunlight and the clearness of the water.

(5) Eye droppers and basters.

(6) Collecting nets: Ideal collecting nets are butterfly nets available in the toy section of department stores. Nets may be made from coat hangers, nylon stockings, cheesecloth, tape and wooden stakes such as broken hockey sticks or broom handles. Plankton and seine (minnow) nets may also be used.

Small hand dip nets are primarily used for collecting insects and other small aquatic life on the surface of the water, among plants, and under stones and logs along the shore. A circular frame is needed for attaching the net bag. Bend a coat hanger into a ring about 8 cm. in diameter. Make a net bag from organdy, nylon stockings, or cheesecloth about 12 cm. deep. Sew the bag onto the ring. Fasten the ring and bag to a stick or pole about 8 cm. in length.

A flat-bottomed net is used to collect larger aquatic organisms throughout the water column. Bend the coat hanger wire into a D-shaped frame about 35 cm. in diameter. Make a net bag from cheesecloth, nylon stockings, or netting of a 3 mm. mesh, about 60 cm. in depth. Sew the bag onto the frame. The frame and net bag can then be attached to a long pole of up to 90 cm. in length with tape. A broom handle or hockey stick is ideal.



(7) Old spoons or hand trowels (optional).

(8) Bottom samplers: For screening the bottom material an ideal collecting tool is a kitchen sieve or strainer. A hand screen may be used which consists of a piece of screen tacked onto a wooden frame.

Hand Screen

A frame can be built using pieces of wood about 30 cm. in length. A mesh hardware screen of less than 1 mm. is tacked onto the frame. Bottom mud samples are then dug up and placed on top of the screen. Water is poured over it washing the finer particles through. Large stones should be removed by hand.

(9) Thermometer: one per instructor.

(10) Meter sticks or a tape measure.

(11) Rubber boots: These may not be necessary if weather conditions are suitable to allow campers to wade in the water in old shoes.

(12) Clipboards and pencils: Clipboards of thin plywood or heavy cardboard with a pencil attached are needed for each person.

(13) Field guides: A general identification key will benefit the boys and girls while in the field. The Golden Nature Guides have a publication entitled Pond Life, which is ideal for identifying some of the more common forms of life the campers will find. Freshwater Ecology by W.A. Andrews, 1974 is also helpful. References such as the Ministry's education fact sheet on Aquatic Insects and Plants could be used (Appendix IV).

(14) Study sheets: one for each person. See Appendix II.

(15) Summary Chart: one. See Appendix III.

FIELD TRIP ACTIVITIES

(1) Divide the children into two groups -- one group will sample the "pool" or slow flowing site, while the other group will sample the "riffle" site.

Start both groups sitting together on the stream bank examining the "HOME". Complete the Study Sheet questions under HOME, having the children from each group conducting the necessary measurements. With younger children, have them view the site and discuss it with the instructor. With an older group, go through all the questions. Each group writes down only the answer for the site they are sampling (pool or riffle). On the summary chart the instructor records both values.

DEMONSTRATION A: MEASURING CURRENT VELOCITY (for older children)

Measure off a distance with the measuring stick. Drop an article, a ball, fishing bobble, stick, etc. into the stream and record the time required to cover the measured distance.

(2) Then, when the two groups separate, further divide each group into smaller teams (usually pairs) to sample one of the following locations.

(a) open, running water -- use collecting nets
(b) rocks -- use collecting nets and basters and trowels
(c) vegetation -- use collecting nets and trowels
(d) sediment -- use sieves, trowels and basters

Give each team the equipment necessary to sample a/b/c or d. The team members should place the plants and organisms they collect in their own sorting tray.

(3) After sampling, each camper should complete his study sheet using the organisms his team collected.

(4) In summary, trays from both the teams and groups should be brought together and the organisms found in each home (a/b/c or d above) between the pool and riffle sites should be compared and discuss how they were adapted to their home.

(5) Have the campers return all the organisms to their original areas.

FOLLOW-UP ACTIVITIES

For Younger Children

(1) Partake in creative Tasks to discover more about the aquatic area.

Creative Tasks

Find something that is increasing in number and something that is decreasing and prove it!

Find and observe indirect evidence of a population of something.

Find a good change and a bad change. Explain.

Find a change that is predictable.

Find objects that are:

(1) hard/soft
(2) big/small
(3) high/low
(4) ugly/beautiful

Map something in the pond you cannot see.
What is the oldest thing around the pond?
Draw something you really like.
Prove that something in or around the pond changes.
Find something around the pond that makes you feel good - sad - angry.
Find something in or around the pond that is useful to you.
Find a predator and who or what is preyed upon.
Draw a cross section of the pond.

Colours - Name the colours you would use to show a picture of a pond and draw it.

(2) Pond Add and Subtract

tin + aspects - tap

___ ___ ___ ___ ___ ___ ___

from + cat + gill - cat - mill

___ ___ ___ ___

moss + quite + pot - step + am - o - am + boat - bat

___ ___ ___ ___ ___ ___ ___ ___

snake + gilled - keg - led

___ ___ ___ ___ ___

tame + addition + pole - am - edition

___ ___ ___ ___ ___ ___ ___

wait - it + tea + rat - a - at

___ ___ ___ ___ ___

(3) Draw a picture about the trip to the pond.

(4) Collect pictures describing water usage in the community.

(5) Have the children try to decide how to improve a "dirty" stream.

FOLLOW-UP ACTIVITIES

Older Children

(1) Discuss and redefine the participants' definitions of a stream.

(2) Speculate about the data that was collected and the accuracy of the measuring techniques. Encourage them to suggest some techniques of their own.

(3) Compare the populations in various areas, e.g. How many specimens were adults? How many were in fast moving sections? How many live on the bottom? Is this ratio the same as in the spring? Summer? Autumn? Winter?

Do a particular population study on one species in the aquatic area. e.g. crayfish.

(4) Construct a food chain or web using the organisms you find in the stream/pond.

(5) Test the water quality of the area with a simple water testing kit, obtained from a local science equipment supplier.

What is the Water like?

Using the test kits, measure the amounts of the following material in the river water (or swamp, or tap).

Chemical	Amount Found	Good Water Quality
Oxygen		more than 5 mg/l
Carbon dioxide		about 10 mg/l (at 25/l things will die)
pH		between 7 and 8.5
Phosphate		.08 mg/l or less

FOLLOW-UP ACTIVITIES

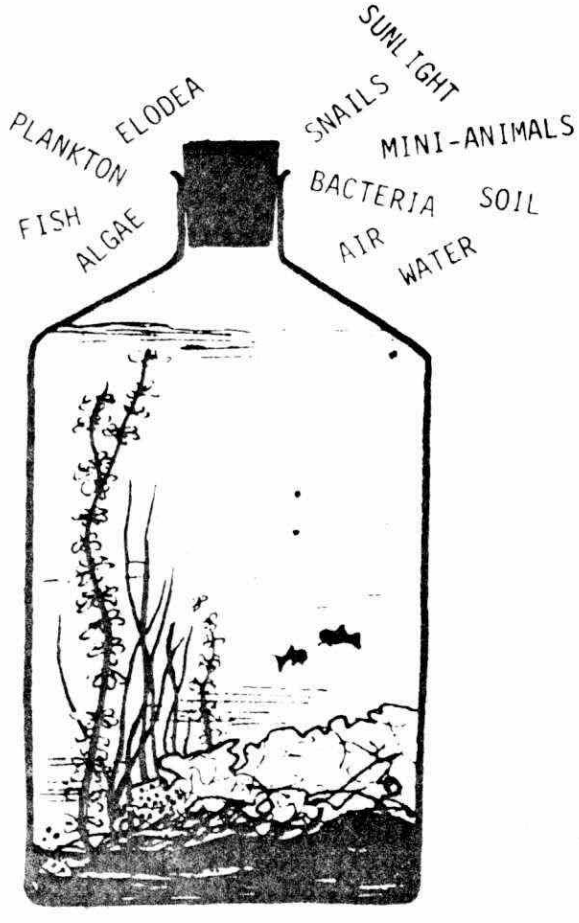
All Ages

(1) Measure water temperature at various depths of the pond or stream. Graph results. What do they mean?

(2) Construct a closed ecosystem.

I INTRODUCTION

Construction and observation of a closed ecosystem can help the average camper develop many basic ecological concepts. What are the basic requirements of living things? Why is sunlight so important? How is oxygen produced? These are some of the questions a closed ecosystem can generate.

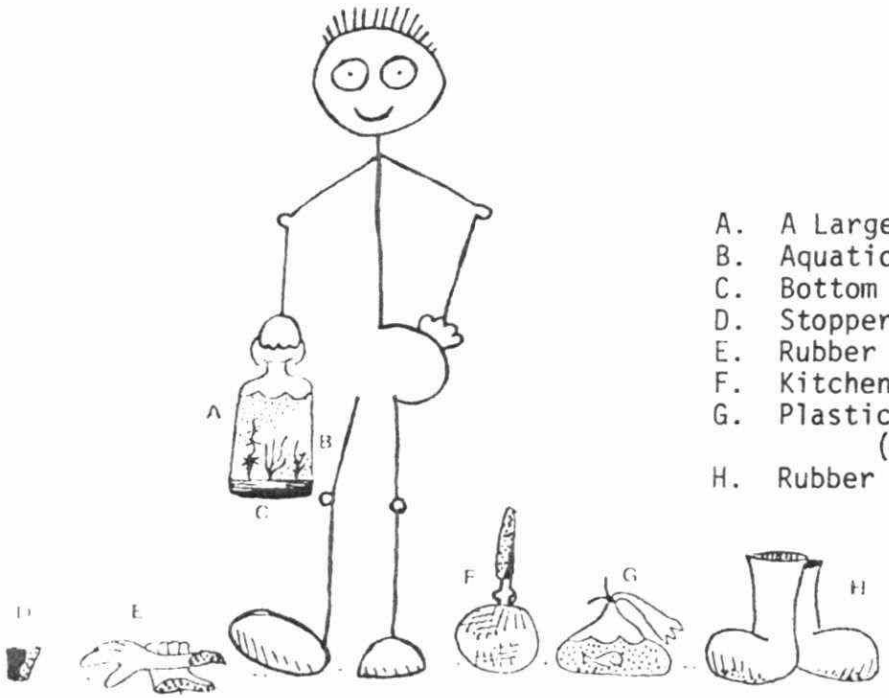


II THE ECOSYSTEM CONCEPT

Ecology can be simply defined as the study of the relationships of living things to each other and their physical environment. In any given community there is always tremendous interaction between the living (biotic) and non-living (abiotic) components. The cyclic transfers between populations of plants and animals in a community and their non-living environment are implied in the term ecosystem.

What is an ecosystem? Why study one? Especially why study a miniature one is a bottle?

By building a miniature closed ecosystem one can actually witness the intricate workings of an interacting community relying only on the input of light energy for maintenance. The complexity of this system and the cyclical pattern of life will become apparent over a prolonged period of time. And, the beauty of it all is that once set up, no further work is required, just close observation.



A. A Large Bottle
B. Aquatic Plants (Algae)
C. Bottom Sediments
D. Stopper or Lid
E. Rubber Gloves (Optional)
F. Kitchen Sieve
G. Plastic Bag and Guppies (Optional)
H. Rubber Boots (Optional)

III CONSTRUCTION OF AN ECOSYSTEM

1) Obtain as large a bottle as possible (preferably one with a lid, or one that can be stoppered).

2) Clean the bottle thoroughly.

3) Visit either a slow-flowing stream or, preferably, a pond or lake shore. A site where aquatic plants are growing will probably yield a variety of aquatic life, both plant and animal.

4) Scoop approximately two to three inches of bottom sediment into the bottle. If there are aquatic plants (especially algae) at the site, obtain a portion of these. (A kitchen sieve will act as a net to catch tiny aquatic organisms that might live amongst the aquatic plants.)

5) Fill the bottle three-quarters full with water obtained at the site.

6) Return the bottle to the camp and place it on a window ledge--avoiding direct sunlight or the temperature will become too high.

7) If aquatic plants could not be obtained from the collection site, a visit to a local tropical fish store will be necessary. Purchase a few strands of an aquatic plant such as Canada Water Weed (Elodea). If you haven't obtained some snails in your original sample then it might be wise to purchase some of them as well. If you want fish in your ecosystem, three of four small guppies might be purchased. (Remember, the guppies will eat some of the other life.)

8) Carefully insert the aquatic plants into the bottle and secure them in the bottom sediment (if necessary by tying them to a weight such as a stone).

9) If guppies are added to the system, they should first be placed in a plastic bag. The bag and contents should be placed in the ecosystem so that the water temperature in the bag has a chance to gradually become the same as the water in the ecosystem. This is necessary or the fish might suffer from temperature shock and die. After several hours, release the fish from the bag into the larger container.

10) Place a lid on the bottle, but don't seal it.

11) After a few weeks, when the system is functioning and appears to be in some sort of balance, the bottle can be sealed by melting some paraffin wax and applying it around the lid or stopper so that no air can enter or leave.

IV OTHER THINGS TO CONSIDER

1) If time is not a factor, (and it shouldn't be) allow the system to adjust to the light source for several weeks before adding guppies.

2) If space and time is available, set up some experiments, using other bottles to illustrate various ecosystems. For example, you can add or subtract components of the system. More guppies can be added in a second bottle, or sediment might be excluded from a third bottle. Using the one ecosystem as a control, it is possible to see how each of the various components are important to the 'balance' that eventually is established.

3) If chemical testing equipment is available, and the ecosystem has not been sealed, it is possible to test on a weekly or even daily basis the chemical nature of the water. Oxygen, carbon dioxide, and pH levels might be determined and graphed over an extended period to see what changes occur.

Follow-up Activities - all ages

(3) Study the hydrologic cycles. Where does our water go?

REFERENCES

Freshwater Ecology, Andrews, Prentice-Hall Pub.

Science in Action - Streams, McGraw-Hill Ryerson

Life in a Pond, Golden Guide.

APPENDIX I

Background Information

Concepts

(1) Adaptation - adjusting to and accepting without changing the environment.

(2) Modification - changing the environment to make it more acceptable to you.

Pool: a slow moving or stationary water body.
Riffle: a fast flowing streamsite.

STREAM STUDY

From watching youngsters or adults at a pond or stream site, it is evident that some think throwing rocks or trying to catch minnows are the only interesting things that can be done in that environment.

How wrong they are! And how destructive! For in almost any body of fresh water, temporary or permanent, large or small, you have an aquatic habitat which provides the community that lives there with all of its basic needs for survival. This community is composed of animals and plants - some so tiny that we have to use magnifying instruments to see them - whose way of life can be easily disturbed by man's thoughtless actions.

There are a number of sharing and exploring activities which you and your group of youngsters can do at this type of unique outdoor area. These activities can vary from a short exploratory walk along the banks, a study of the physical characteristics of the stream, or an examination of the organisms (living creatures) dwelling on the surface, in the water, in the bottom sediment, or along the shore.

It's all up to you, the ability of your youngsters and the amount of time you have to spend.

Please note: It should be stressed to the boys and girls that they are only guests in the aquatic community and, therefore, they should return all specimens to the water as close as possible to where they found them. Overturned rocks should be replaced in their original position, and plants that are removed should be pulled up with the roots intact and replanted after observations are made.

PHYSICAL FEATURES OF THE POND OR STREAM

Aquatic communities can be found in two areas: 1) in standing water, such as ponds, lakes and swamps, and 2) in running water, such as rivers, creeks and streams.

A. One of the factors which influences which animals and plants will be present at the site is water flow or stream velocity.

For example, organisms which must survive in areas where the water flows very fast must have some ways of protecting themselves from being swept away by the current.

The blackfly and riffle beetle larvae have sucker-like structures on their ventral surfaces to secure themselves to the bottom sediment. A flattened, streamlined shape allows the nymphs of stoneflies and mayflies to adhere to the undersides of rocks and avoid being swept away. Similarly, plants are equipped with strong, sturdy roots and thin pliant stems and leaves so that they won't be broken by the current.

In addition, a site which is composed of rapidly flowing water has an abundant supply of oxygen (the water tumbling over the rocks absorbs oxygen from the air) and thus the life existing there need no special features for removing oxygen from the water.

Conversely, at a pool site, where the water moves in large volume, its velocity is slow and the particles of sediment are be-

ginning to settle to the bottom, the aquatic organisms are faced with limited oxygen and the threat of being buried under the settling particles.

Many organisms, such as the tube worm, that exist in a pool site have special mechanisms to combat these difficulties. The tube worm builds itself a case in which it wriggles. The wriggling action increases the amount of water, which comes in contact with the worm so that the creature has new sources of oxygen. Its casing protrudes above the bottom sediment to prevent the organism from being buried by the settling particles.

To measure water velocity:
Water velocity can be calculated by measuring the distance between two points in the stream and then timing how long it takes an object, such as a leaf, to travel between these points. The distance should be measured in centimetres and then divided by the number of seconds required to travel the distance.

distance between A & B in cm $\div$ time to travel in sec. = velocity of a stream in cm/sec.

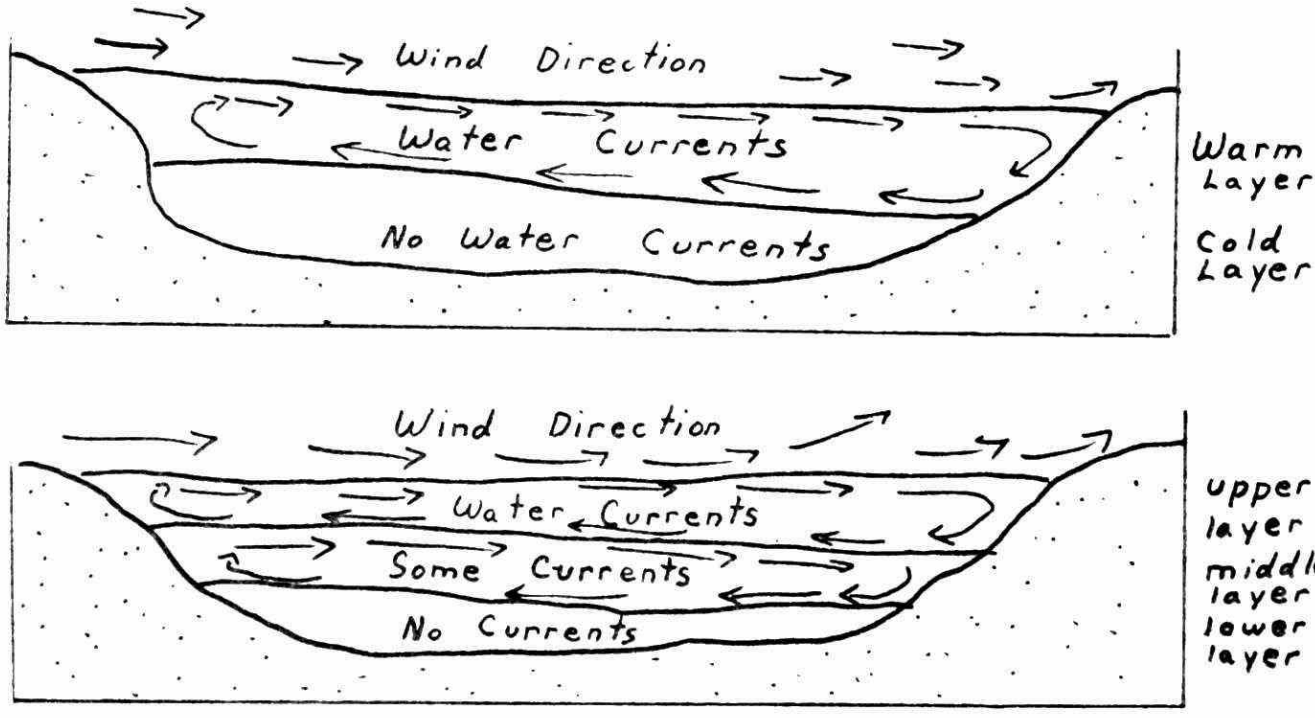
B. One of the major factors acting on a pond or lake is the climate which affects the temperature of the water.

In the spring, the water is usually cold and therefore is able to absorb quite a bit of oxygen from the atmosphere making breathing easier for the fish.

As summer approaches, the sun warms the upper layer of water faster than the wind can mix it. The warmer water is less dense than the cooler water and tends to remain on top creating two distinct layers. Eventually due to water currents three layers form - an upper, warmer, freely-moving layer; a transitional layer; and, the cooler lower layer which receives no atmospheric gases.

This layering is called stratification.

In most cases, the middle layer has the greatest amount of dissolved oxygen. This is because the organisms needing large amounts of oxygen are more abundant in the upper layer and tend to reduce the level of oxygen there.



As the autumn arrives, the water cools until the lake becomes uniform in temperature again.

During the winter as the upper water layer cools, it becomes more dense and sinks to the bottom. This continues until the colder water reaches 4 C or 39 F. Water colder than this remains near the surface and eventually freezes. Again, three layers form - the upper layer is ice and water close to the freezing point; the middle layer is again transitional but this time it goes from cold to warm and the bottom layer is warmer.

The temperatures and the amount of dissolved oxygen will again become uniform when the ice breaks up.

C. Transparency refers to the clearness of the water. Substances such as soil, chemicals, bacteria, plant life, etc. which form small particles and become mixed or suspended in the water and do not disolve can make the water turbid or muddy. (Note: Turbidity is not always an indicator of pollution. A stream can be completely clear and still be highly polluted.)

In studying plant and animal life in water, scientists try to evaluate the quantity, ie the number of each particular species and the quality, ie the number of different species present. As pollution increases, the number of a particular species also increases, while the number of different species decreases. This change occurs because the pollution inhibits the animal life that would normally control that particular species. Therefore, the more variety in species you find in a stream, the less likely that stream is to be polluted.

Some indicator organisms which can be easily recognized are:

1) clean water - insect larvae of May and Black Flies
2) partly polluted water - grey leeches of the non-blood sucking type
3) highly polluted water - aquatic worms. These animals require a very low oxygen supply in order to live.

The boys and girls will be able to find the animals and small aquatic animals on the surface of the water, on or under plants, logs and rocks, in the bottom sediment, and directly in the water.

POSSIBLE STREAM LIFE

Type of stream:	Bedrock	Rubble or gravel bottom	Sandy	Muddy or silt-bottomed
Characteristics:	provides little food and protection	-high stream velocity -carries ample supply of food and oxygen	-no solid rooting material for higher plants and no smooth surfaces for attachment of plants	-abundant rooting material -same characteristics as as pond
Plant Life:	blue-green algae perhaps some fountain moss	-blue-green algae -fountain moss -diatoms -water hypnum -elodea		-diatoms, algae -fountain mosses, hornwo -pickerel weed -water weed, burreed -arrowhead, watercress -duckweed
Animal Life:	-limited food supply therefore limited animal life -nematodes -mayfly nymph	-abundant -nematodes -bristleworm -planaria -larvae of: sponges bryozoans cranefly midge blackfly caddisfly riffle beetle -nymph of: mayfly, stonefly dragonfly, water strider, snails, clams, leeches, trout, minnows	-planaria -nematodes -mayflies -caddisflies -alderflies	-rotifers, copepods -protozoans, nematodes -tubifex, bristle-worm -bryozoans -nymphs of mayfly & dragon flies -caddis worms -midge larvae -amphipod, crayfish, -leech, water strider -water boatmen, snails -clams, sucker, -catfish, northern pike, - yellow perch

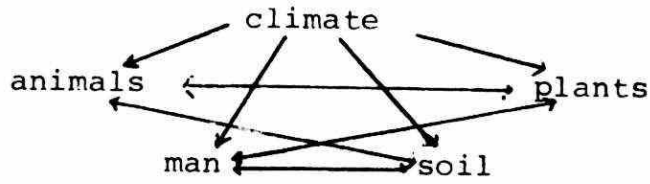
What is an ecosystem?

An ecosystem consists of groups of organisms (living creatures) together with their non-living or physical environment. All the components of an ecosystem - plants, animals, soil, water, air, light, wind and temperature - interact with each other for survival.

For example, plants provide food for some species of animals. In turn, these animals become food for other animals. The physical factors, like temperature, precipitation and soil determine the quantity and the quality of plants available.

Examples of ecosystems are lakes, ponds, forests, oceans and even the world itself.

In a diagram form, the ecosystem concept looks like this:



The amount of oxygen in the air and water is constantly being replenished by the green plants, which give off oxygen during the day when they are manufacturing food for themselves. This food-making process is called photosynthesis and requires water, carbon dioxide and the presence of sunlight. (The carbon dioxide is provided by the plants themselves during the night and by the animals, who give off carbon dioxide when they breathe in the oxygen.)

The plants are also known as producers as they provide the animals with food (their leaves) and oxygen.

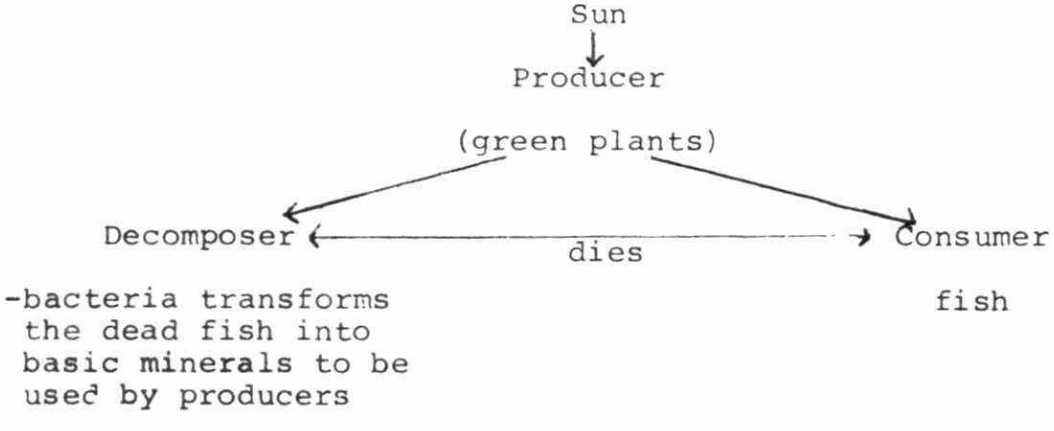
Will the animals ever starve?

If the system is a balanced one, the snails and fish should never go hungry. There should always be enough plants for them to eat. If however, their population should increase to such an extent that the available food supply is inadequate, the weaker members will die off until their numbers are in proportion to the food available.

The animals are called consumers because they use the oxygen produced by the plants and feed either directly on the green plants (this type of animal is called a herbivore) or on the animals that feed on the plants (these are the carnivores.)

Some animals play more than one role. The snails are consumers as well as decomposers.

Decomposers, such as snails, yeast, bacteria and fungi (most decomposers are microscopic creatures) work to break down the dead material and return it to the soil.



Taken from Exploring the Environment with the Handicapped, Ministry of the Environment, Information Services.

AQUATIC HABITAT

The Floor

What colour is the floor of the home? _____

What does the floor smell like? _____

What is the floor made of? _____

Where are the plants growing? _____

The Water

What colour is the water? _____

What is the temperature of the water? _____

Speed of the Water

What is the distance? _____ cm.

What is the time? _____ sec.

The speed of the water is (distance/time) _____ cm/sec.

The Homeowners

Complete the chart on the back of this page.

THE HOMEOWNERS

Homeowner (draw it)	Where Found	Colour	Length	Shape*	How does it move?	How is it made to live there?

*shapes: flat, round, cylinder, rectangle, triangle

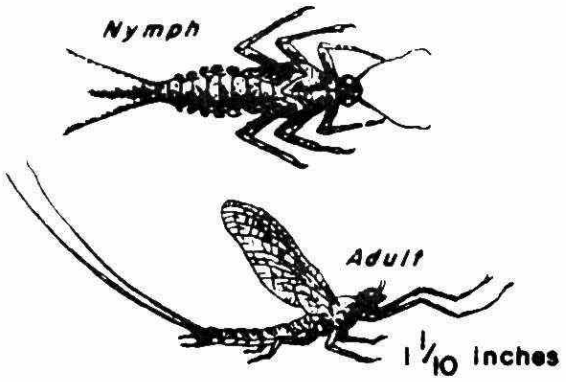
APPENDIX III

AQUATIC SUMMARY CHART	
POOL	RIFFLE
FLOOR dark brown smells like rotten eggs made of mud, sticks, weeds weeds along the edges, and in the middle	light brown no smell made of stones, mud weeds stuck to rocks
WATER dark clear colour 20°C speed is 3 cm/sec	light clear colour 20°C speed is 20 cm/sec
sludgeworms roundworms dragonfly nymph tadpoles water strider whirligig beetle midge mosquito larva	crayfish caddisfly larva mayfly nymph stonefly nymph snails clams

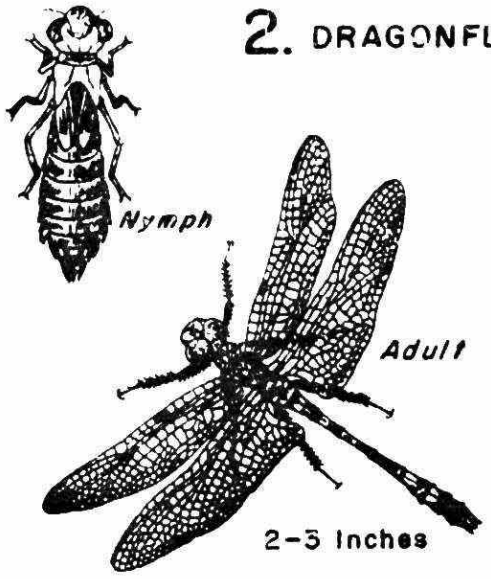
APPENDIX IV

AQUATIC INSECTS

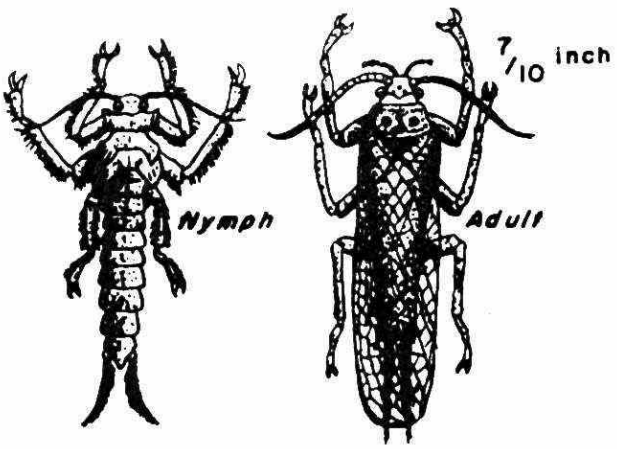
(REPRINTED WITH PERMISSION OF OREGON DEPARTMENT OF FISH AND WILDLIFE)



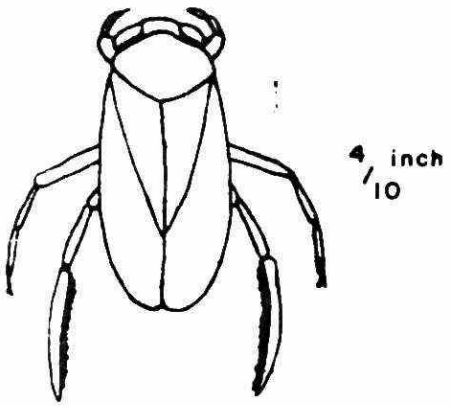
1. MAYFLY



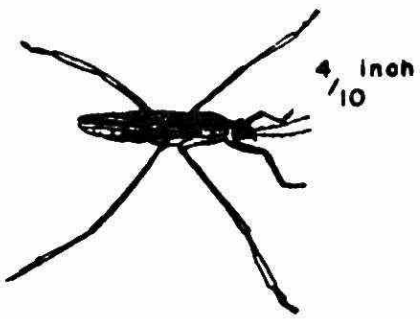
2. DRAGONFLY



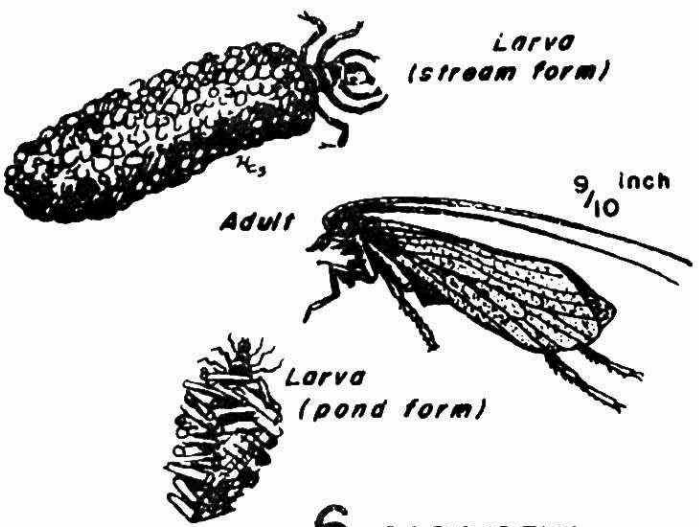
3. STONEFLY



4. WATER BOATMAN



5. WATER STRIDER



6. CADDISFLY

AQUATIC INSECTS

1. May Flies (Ephemerotera)

May flies are abundant in streams and lakes and can be found in practically all fresh water throughout the state. The nymphs are found on the undersides of rocks or other underwater objects. They have two or three tails. The wings of the adult are held in an upright position while resting.

2. Dragonfly (Odonata)

They are found in all types of fresh-water areas; ponds, lakes, streams, and swampy areas. The nymphs can be found crawling about on the bottom, on aquatic plants, or other underwater objects. They are one of the largest aquatic insects; most of them are dark brown to greenish as juveniles, change to brighter colors as adults. When resting, their four wings are held outstretched.

3. Stone Fly (Plecoptera)

Stone flies seem to require running water in which to live. They are never found in lakes except in the inlets and outlets. When the adult is resting its wings lie lengthwise upon the back. Nymphs are found in abundance only among the rocks in streams. Stone fly nymphs have two long and stiff tails.

4. Water Boatman (Hemiptera)

Boatmen are found in nearly all waters. They swim in an erratic pattern underwater, and usually found in slow moving waters. Boatmen are normally brownish in color and equipped with leathery wings.

5. Water Strider (Hemiptera)

Water striders are a familiar sight on the surface of slow moving waters, ponds, and lakes. They resemble long legged spiders. Although equipped with wings, they are rarely observed in flight. Their color is usually brown to gray. Many persons call them "water skippers".

6. Caddis Fly (Trichoptera)

Caddis flies are found in nearly all lakes, streams, and ponds. During their underwater life, they live in cases made from sticks and small particles of rock. These can usually be seen moving about on the bottom. When the adults are at rest the wings are held roof-like over the body and sloping down at the sides. The adults are generally dull brown or black in color. Sometimes the larvae are called "penny winkles" by fishermen. "Periwinkle" is another common name.

AQUATIC INSECTS

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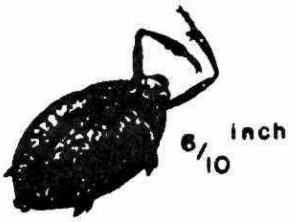
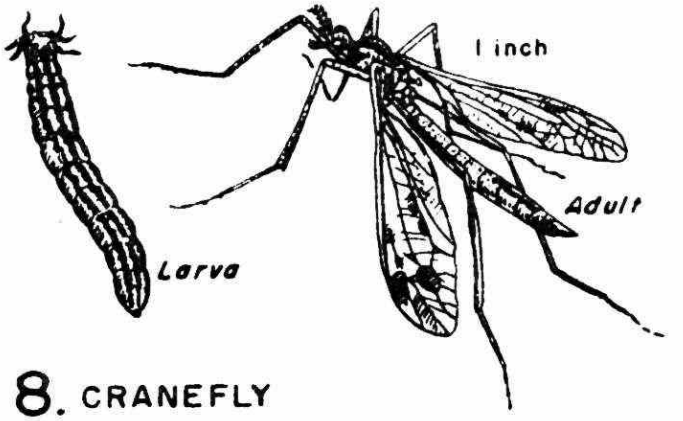
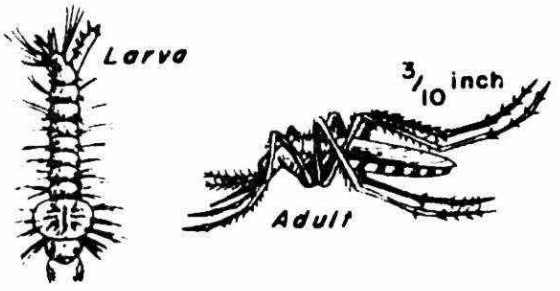


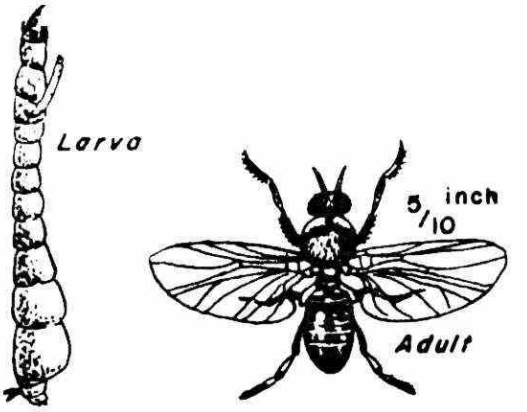
7. WHIRLIGIG BEETLE



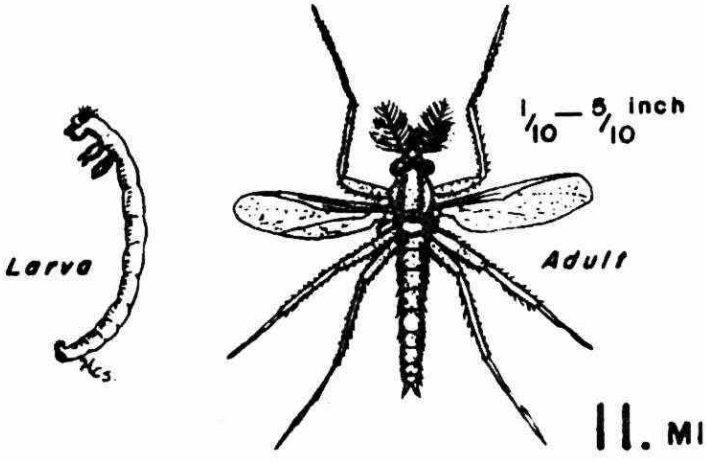
8. CRANEFLY



9. MOSQUITO



10. BLACK FLY



11. MIDGE

AQUATIC INSECTS

7. **Whirligig Beetle** (Coleoptera)

These are found on the surface of slow moving waters, taking advantage of the surface tension. The Whirligig beetles, true to their name, whirl or swim on the water's surface. When disturbed they dive under the water, frequently. Their bodies are dark colored, robust, and the front legs are long and slender.

8. Crane Fly (Diptera)

The larvae of the Crane fly are found in scum of shallow waters, in the damp soil along streams or lake shores, and marshy areas. The adults are never truly aquatic and may be found great distances from water. The adults look much like giant mosquitoes without a beak.

9. Mosquitoes (Diptera)

Mosquitoe larvae are usually found in stagnant slow moving water. Most people are familiar with the appearance of adults and know that they are more abundant around marshy, damp areas. The young are often called "wigglers" and can usually be found wiggling about just under the water's surface. Contrary to popular belief, not all mosquitoes bite, the males just buzz and are not equipped for biting.

10. Black Fly (Diptera)

The larvae are found in flowing water (only) on stones, vegetation, or other objects, usually in the swiftest part of the stream. In many cases, the larvae are so numerous they appear moss-like over the surface of the attached object. Later on in life, they live in a cocoon which is customarily a boot-shaped structure. The Black fly as the name implies, are usually dark compactly built flies, with rounded black and short broad wings. The adults may be found great distances from water.

11. Midges (Diptera)

Larvae are most abundant in the shallow water areas of lakes, ponds, and streams favored by a heavy growth of aquatic plants. They prefer soft mucky bottoms, as they are a bottom-dwelling species, and need this type environment for constructing their tube-like homes. Larvae live in soft tubes, however, during later stages of life they are found living in silken cocoons or gelatinous cases. The adult Midges look much the same as mosquitoes. Their antennae look like two feathers on the front of their head and they don't have a beak.

SUB-SURFACE FRESH WATER ORGANISMS

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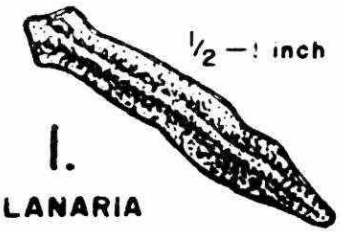
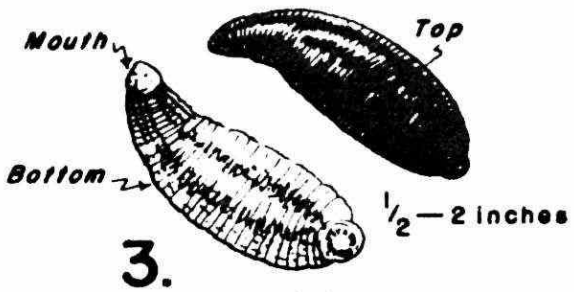
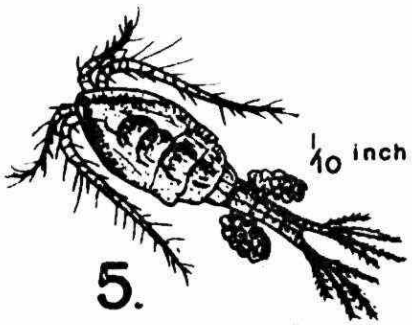


1. PLANARIA

2. BRYOZOAN COLONY

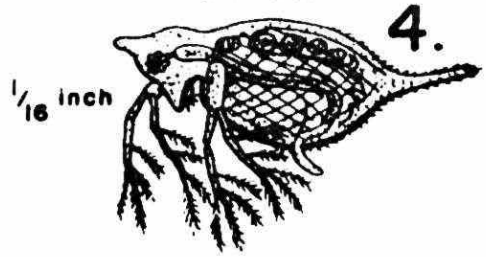


3. LEECH



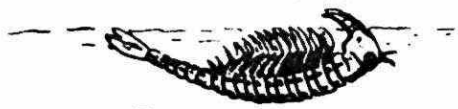
5. CYCLOPS

DAPHNIA

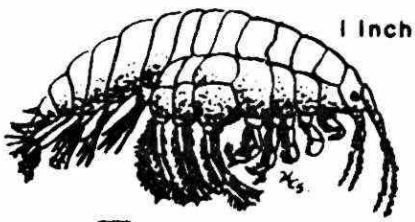


4.

FAIRY SHRIMP 1 inch



6.



7. FRESH WATER SHRIMP

SUBSURFACE FRESH-WATER ORGANISMS

1. Planaria (Turbellaria)

Planarians are fairly common in ponds, lakes, springs, and other fresh waters among vegetation, beneath stones, or crawling over the bottom. These free-living flatworms are usually arrow-shaped and vary in color from white to black depending on species and environment. Small planaria look much the same as the adult differing only in size.

2. Bryozoan Colony (Broyozoa)

Fresh-water Bryozoa are very common in lakes, ponds, and rivers. They are community dwellers, living in jelly type substance which is formed on sticks as a gelatinous ball or a mossy mat over the surface of underwater objects. There is a wide range in color, some colonies are brownish and still others have a greenish tinge. Colonies are made up of thousands of these tiny animals.

3. Leech (Hirudinea)

Leeches make homes in lakes, ponds, or other fresh-water areas. They can be seen moving about underwater by their well-known "Measuring "orm" type of travel, or swimming freely. Leeches are predatory or parasitic segmented worms with sucking discs which are used in attachment, movement, and feeding. They are usually dark brown to black in coloration.

4. Daphnia (Cladocera)

Daphnia are found in all sorts of fresh waters. The shallow, weedy backwaters of a lake whose water level is fairly permanent harbors greater numbers that any other kind of locality. These little crustaceans are virtually transparent, and are best recognized by their two-branched antennae, robust bodies, and sharp-tail spine.

5. Cyclops (Copepoda)

These little fresh-water crustaceans are very familiar in all slow moving waters, especially shallow ponds. Their bodies, like the Daphnia, are very transparent and are characterized by the forked antenna and the branched tail. The female usually has two groups of eggs attached to her body just ahead of the tail.

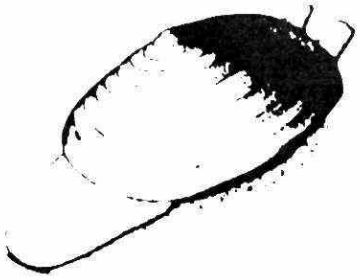
6. Fairy Shrimps (Anostraca)

For the most part, fairy shrimps live in temporary pools and ponds of fresh water. They are frequently seen underwater, rowing themselves about on their backs, by means of numerous, similar, flattened appendages. These appendages are always faced toward the source of light.

7. Fresh-Water Shrimp (Malacostraca)

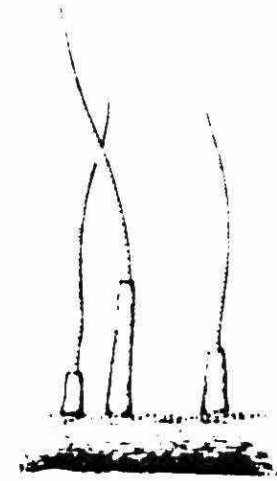
These are found in lakes, streams, and ponds in eastern and western Oregon. Shrimp are usually found among the aquatic plants, rocks, and algae. Usually they are nearly transparent and look something like a "sow bug".

FRESH-WATER ORGANISMS

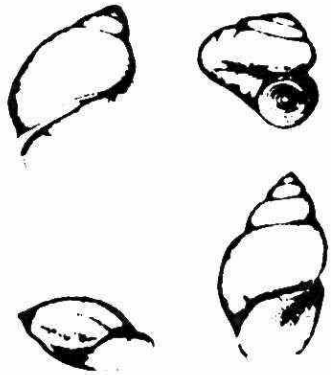


1. CLAM

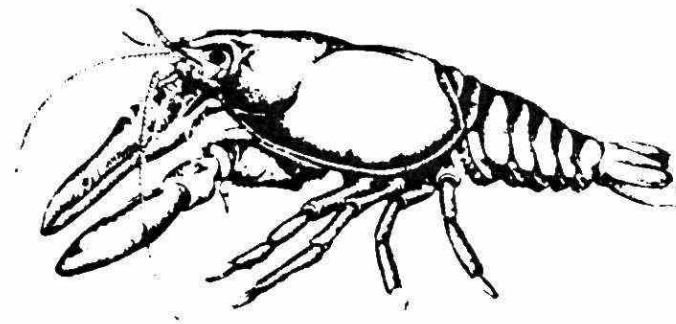
2. ROUNDWORM



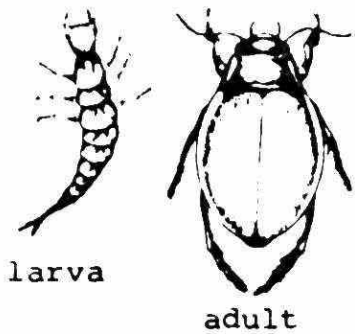
3. SLUDGEWORM



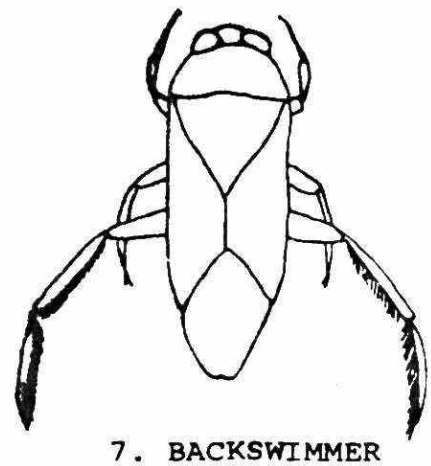
4. SNAILS



5. CRAYFISH



6. DIVING BEETLE



7. BACKSWIMMER

FRESH-WATER ORGANISMS

1. Mussel/Clam

This organism is fairly immobile and therefore must have its food brought to it. It is fairly common in large rivers and wave-swept sections of lakes where it can filter tiny food particles from the water. When winter approaches the animal must burrow to avoid killing due to cold. In this case, it is equiped for movement with a 'foot'.

2. Roundworms (Nematodes)

These organisms wriggle their needle-like bodies through mud or debris, searching for protazoans or other worms as food. They are very well-adapted to low oxygen levels and can survive well in the stream bottom sediments. This animal does not have a segmented body as compared to sludgeworms.

3. Sludgeworms (tubifex)

This is a well-adapted segmented worm which can tolerate extremely low oxygen, especially in polluted waters where bacteria are present. The organism builds a tube above a burrow extending down to bottom materials. It's tail sticks out of the tube as the animal feeds on its way down. It's tail waves in order to exchange carbon dioxide and oxygen.

4. Snails

Snails forage for algae in many parts of the stream. They often coat bottom debris and leaves and stems of aquatic plan

5. Crayfish

These resemble miniature lobsters. Crayfish can walk a few yards from their dens in search of food to gather in its sharp claws. It is essentially a scavenger but is aggressive when challenged and cornered. A crayfish swims backward using its powerful tail but will attack using its claws if intimidated. Some crustaceans have varying size claws because of losses in previous battles.

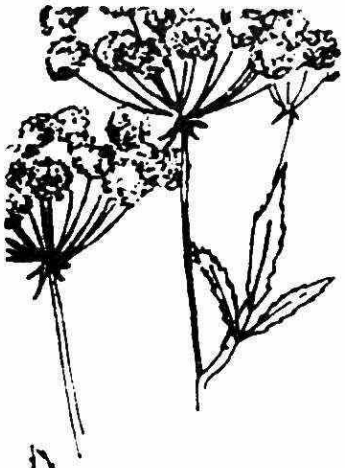
6. Diving Beetles (dytiscus)

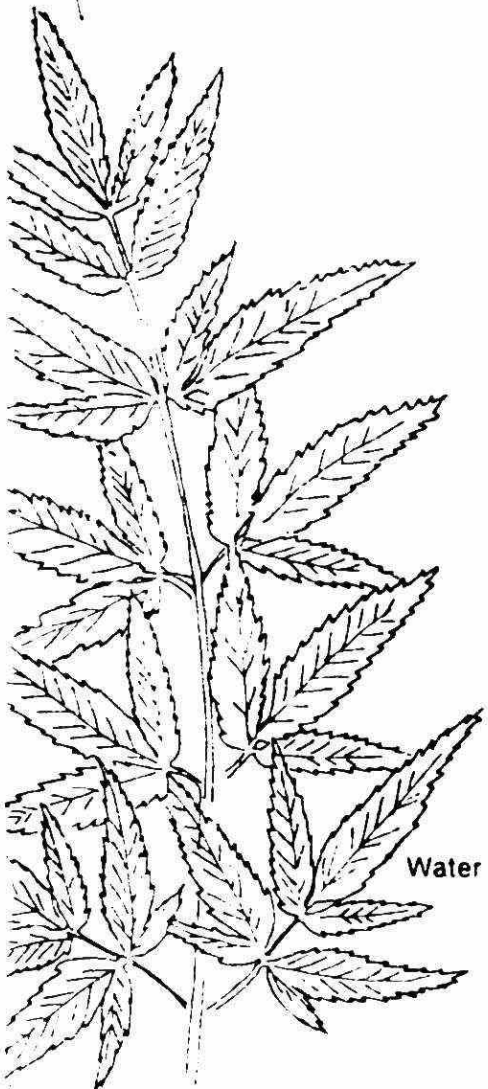
These are predaceous, active killers. They have large pointed jaws that can pierce the hard outer shell of most other insects, eg: caddisfly home. They can be found in many areas of the stream.

7. Backswimmer

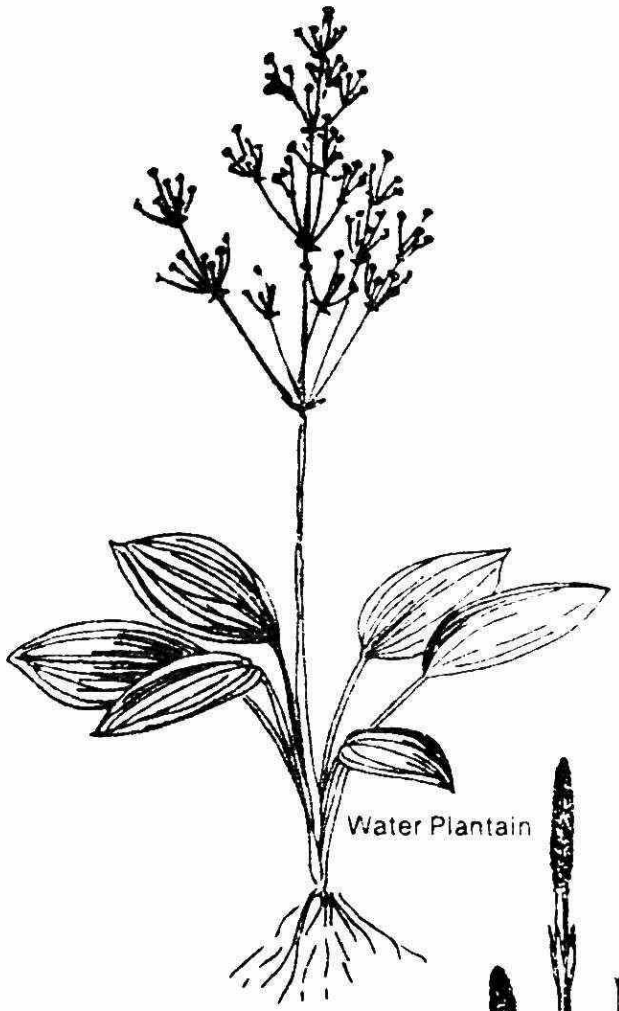
These are air-breathing insects that dangle from the surface of the water waiting for food. They have long powerful swimming legs and a pointed 'beak' for capturing prey. This insect swims upside down when attacking its prey.

EMERGENT PLANTS

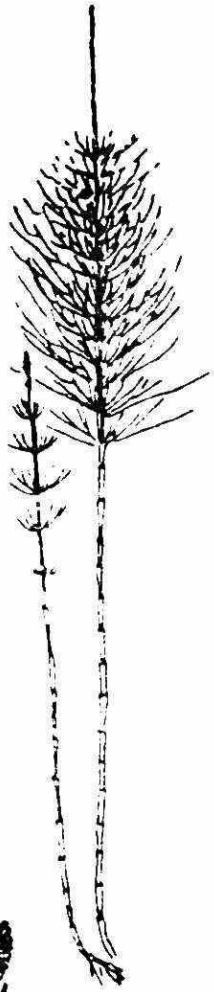




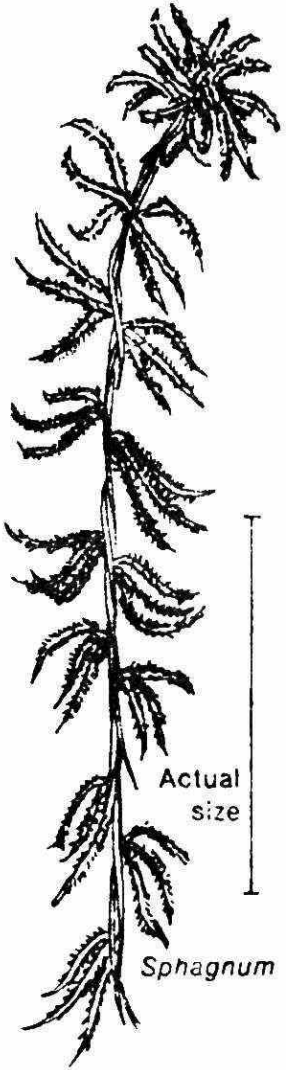
Water Hemlock



Water Plantain

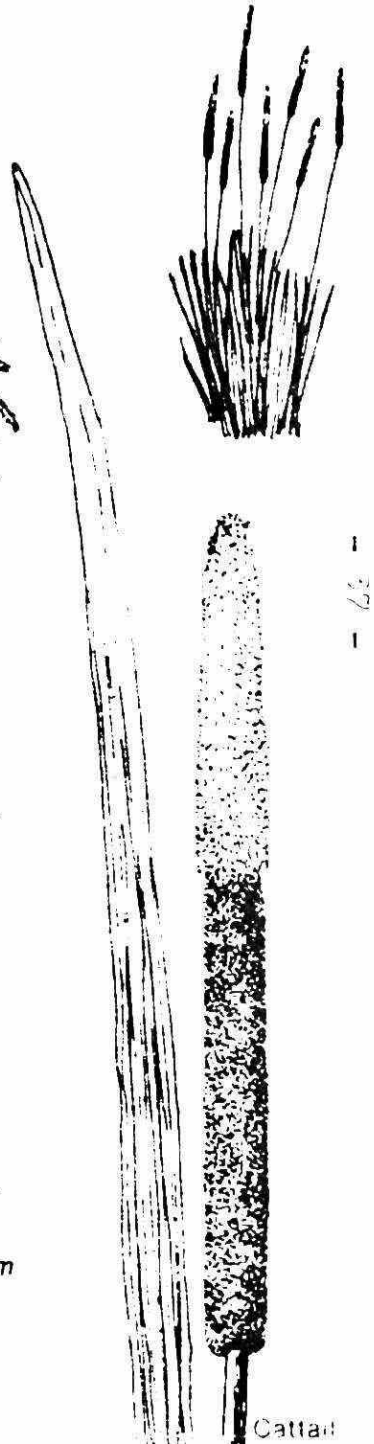


Horsetails



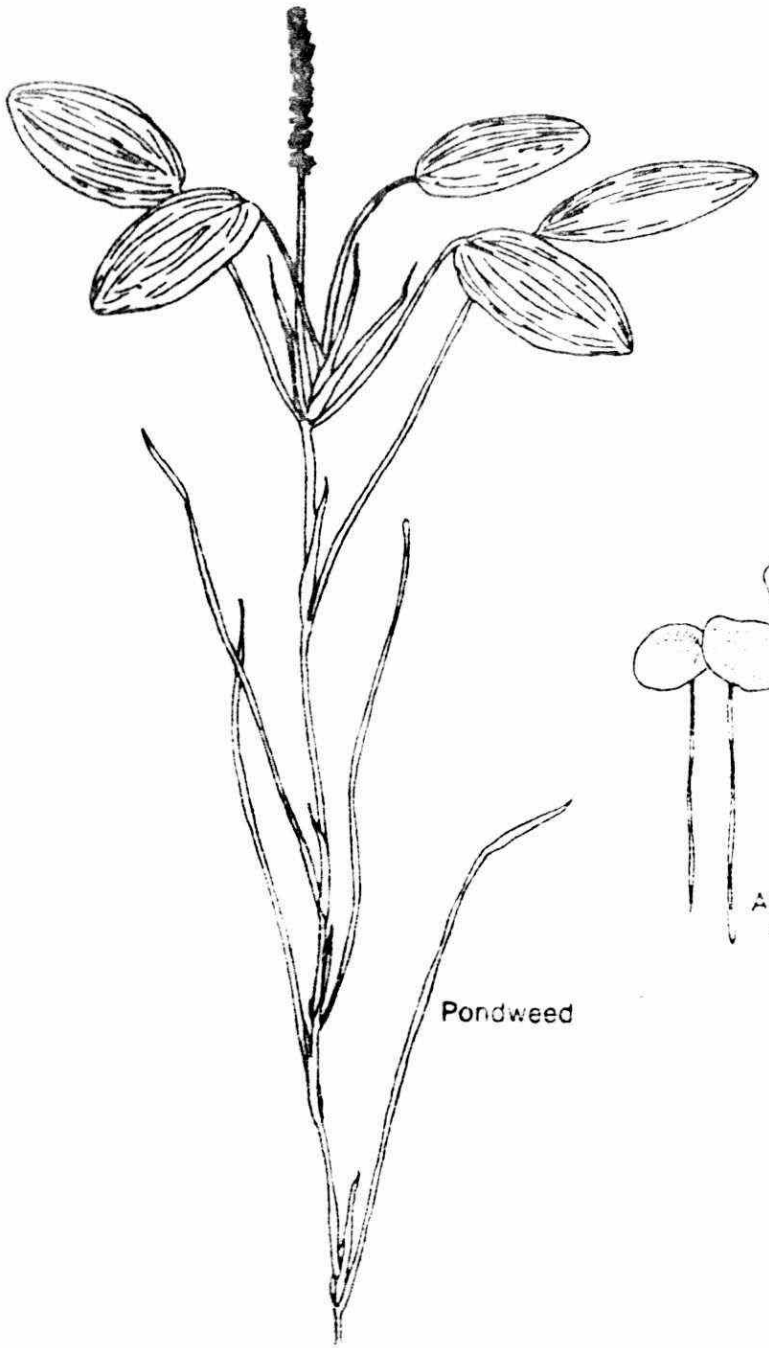
Actual size

Sphagnum

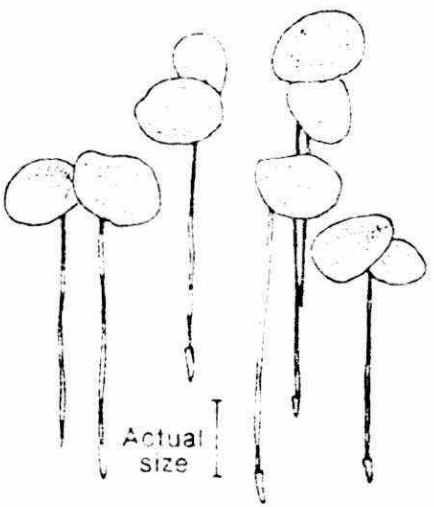


Cattail

FLOATING PLANTS OR FLOATING LEAVES



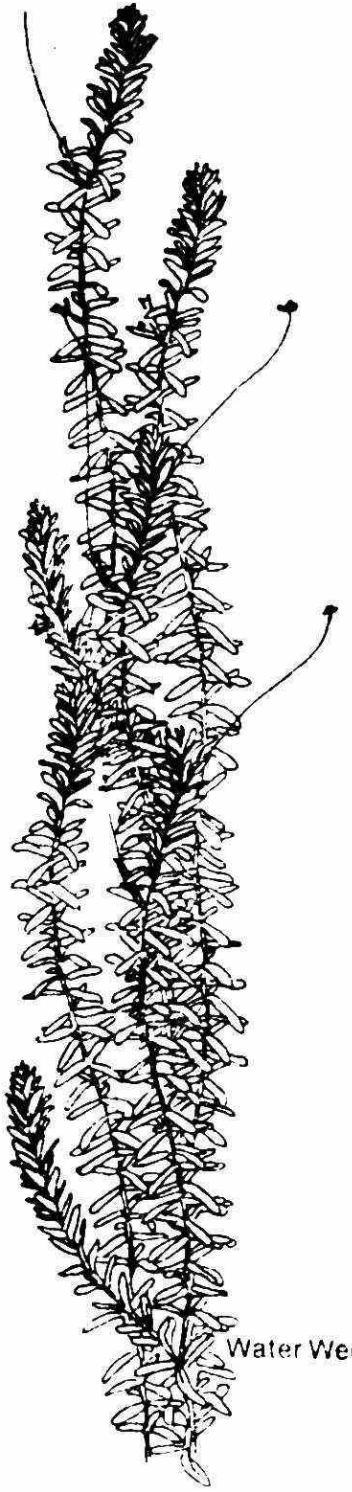
Pondweed



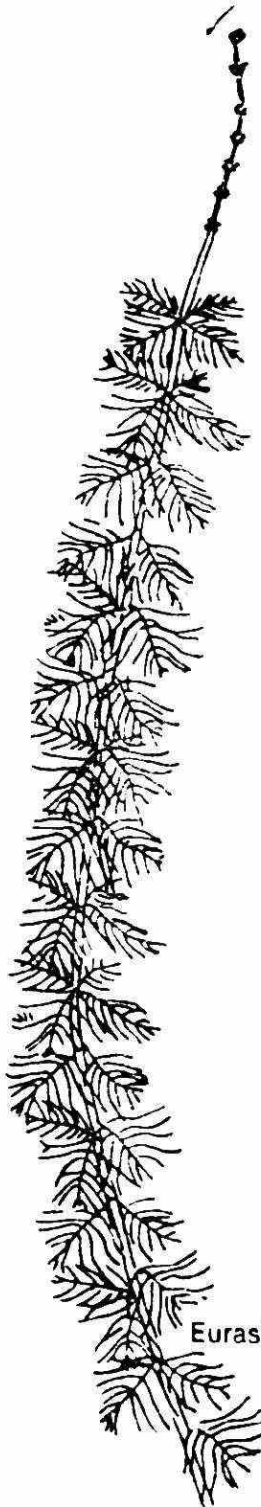
Duckweed

Yellow Pond Lily

SUBMERGED PLANTS

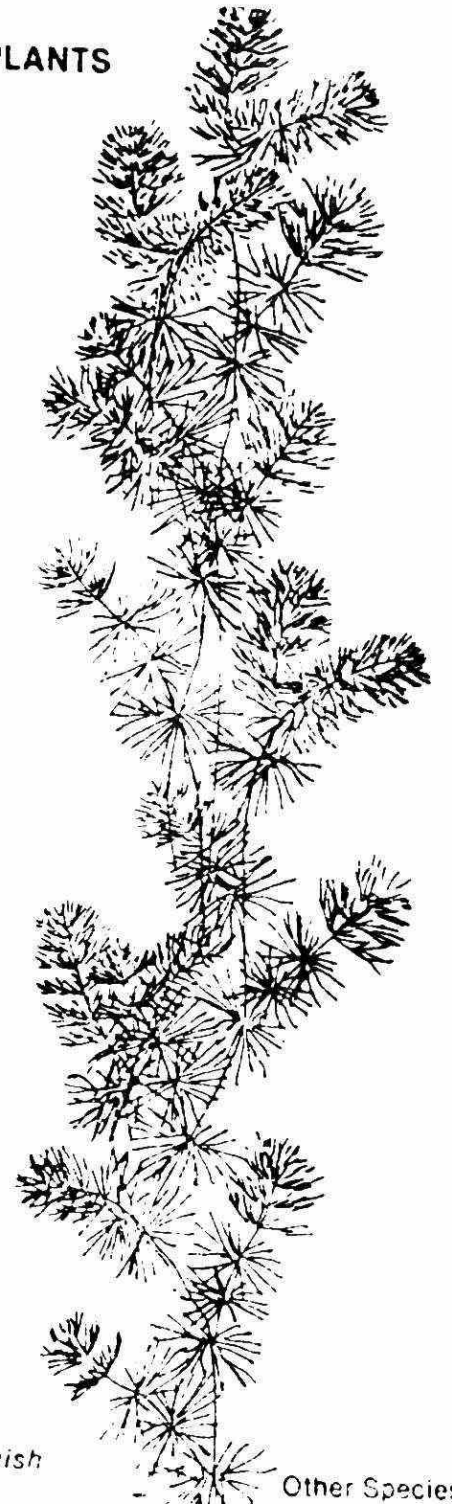


Water Weed



Eurasian Water Milfoil

After Jeanne R. Janish



Other Species of Water Milfoils

NATURE STUDY

INTRODUCTION

A nature study involves a variety of awareness activities in the natural environment. They do not have to be one-time outings. Experience the woodlot or beach during the spring and again in the fall.

The instructor may choose various studies according to the age level and background of the campers.

OBJECTIVES

(1) To use art and language skills to become aware of the environment.
(2) To provide a chance for the imagination and senses to be developed.
(3) To develop an understanding of nature as a whole and appreciate the many inter-relationships involved. Destruction of one area can be detrimental to the complex food web.
(4) To provide a means for development of identification skills.

CONCEPTS

(1) Nature has incorporated minute detail in its construction of all things.
(2) The complexity of living things in the natural environment is brought out by the fact that there is nothing in this world that doesn't change.

PRE-FIELD TRIP PREPARATIONS

For instructors unfamiliar with field outings, a good reference book is Shirley Brehms, A Teacher's Handbook for Study Outside the Classroom (Merill Pub. Co.).

Choosing the Field Site

The instructor should previously consider a suitable site to carry out any investigations. These sites will vary according to the activities chosen. A safe area is free of poison ivy, poison oak and dangerous objects. It is stressed that the site be visited beforehand by the teacher, in order for the campers to benefit from planned activities. Avoid long hikes on very warm days or around mid-day when the sun is the hottest.

Clothing and Equipment Required by the Student

1. Comfortable walking shoes. (Shoes that will protect their feet as well as ones that will stay on (no thongs)).
2. Socks
3. Jacket or sweater if cool weather
4. Rain gear if unfavourable weather.
5. Shorts or slacks for all students depending on weather.
6. Pen and clipboard.

Note: It is stressed that the study is held outdoors unless the weather is so unfavourable that such an endeavour would be detrimental. In this case the study will be replaced by rainy day indoor activities.

Activities Beforehand

As a leader, you do not have to be a naturalist to lead the hike. The ability to rhyme off the names of all the animals, plants, trees, birds and insects is nice to possess but is not nearly as important as being able to get your youngsters to see, touch or smell the environment. Young people will never remember the names of all the things they see but will remember how nice a flower smelled or how rough a piece of bark felt. Your basic goal is to encourage greater observations and insights.

Preparing the children physically is most important (i.e. proper dress). Use of field guides may be practised (for older children)

but generally is not necessary. The outdoors must be experienced to be appreciated. Nature can hold exciting adventures for both young people and adults.

FIELD TRIP ACTIVITIES

Guidelines

Begin the outing by reminding the group that they should not pick wildflowers, break branches from trees, crush toadstools and mushrooms, destroy spider webs or step and run through the woodlot without looking out for the tiny, new trees that are trying to grow in the soil. In other words, they are going to be quiet, courteous, and aware that they are guests of nature. All they should leave along the way are their footprints.

The general approach that should be used is frequent and short stops along the way which will depend on the group's interests and their attention span. Stop every time you notice well-known trees, plants, insects, unusual patterns or designs in tree bark, animal homes, birds and bird nests, animal tracks or feathers. In other words, point out to the youngsters the world they are living in.

Look for colours, light and shadows. Look for size comparisons like a tall tree and a tiny seed; and child and an ant. How many different shapes of leaves can you see? Are there any baby trees (saplings) growing along the trail? Are they the same species as a nearby living tree?

Feel lichen growing on a tree and compare it with the feeling of moss. Feel the bark of several different trees. How is it different? Describe.

Smell the leaves on the ground. Then smell the leaves from a nearby bush. Do they smell the same? Why not?

Look at tree branches in the winter. What do they tell us about themselves? (See section on trees)

Does snow look and feel the same in all parts of the woods?

How much light is coming through the trees? Lie down on your backs and imagine you are young trees (saplings) trying to find the sunlight. Is this a good place to grow? Try to find a better home.

Listen for bird calls, wind and rustling leaves. Which sound is the loudest? If you were a rabbit, where would you want to hide along the trail? Pretend for a moment that you are going to move into the forest, where would you make your home? How many different kinds of insects can you find on the bark of a tree? How many can you find on the ground underneath the tree? Look underneath rocks for life but remember to turn the rock back over the way you found it.

Allow the young people to explore and no doubt you will be surprised at how observant they become. Let them tell their adventures to other members of the group and to point out their precious finds.

Walk along the same trails in all the seasons. Notice the changes. Try to walk through contrasting environments such as an open field in comparison to a dense woodlot; a swampy area and the beach; along a road in comparison to a forest's edge. These diverse habitats will maximize the possibilities for an enjoyable and happy hike.

Perhaps you would like to design your hike around a particular area of interest, for example:

- animal signs
- wildflowers
- non-flowering plants - lichens
  ferns
  mushrooms
  poison ivy or poison oak
- trees
- insects
- birds

Activity: Camouflage (younger children)

Equipment

several different colours of toothpicks (50 of each)

Explanation

Place toothpicks in a lawn, a forest or a field. Tell the children they are birds looking for insects (or a similar analogy). Have them collect as many toothpicks as possible.

Generally, fewer "camouflaged" toothpicks will be found, i.e. green toothpicks in green grass. Discuss the natural implications this may have. Think of examples of camouflage in nature.

Activity: Leaf Rubbings, Leaf Stamps and Sunprints (young children)

Materials

leaves
stamp pad
crayons
paper
coloured construction paper
pins or small rocks

Explanation

Have the children choose one or several leaves. Use the crayons and stamp pad to reveal texture and outline.

Leaf Rubbings

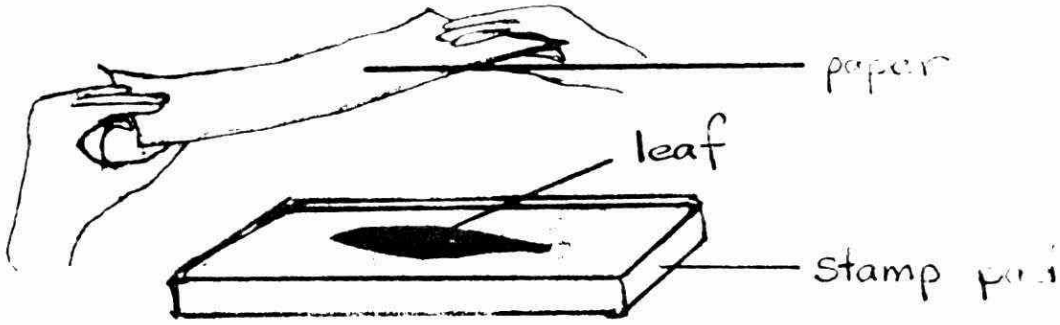
1) Have the children place one or several leaves underneath their paper on a flat surface. (tabletop, clipboard, etc.) Take the crayon and rub overtop of the leaves on the paper to bring out the texture in the leaves.

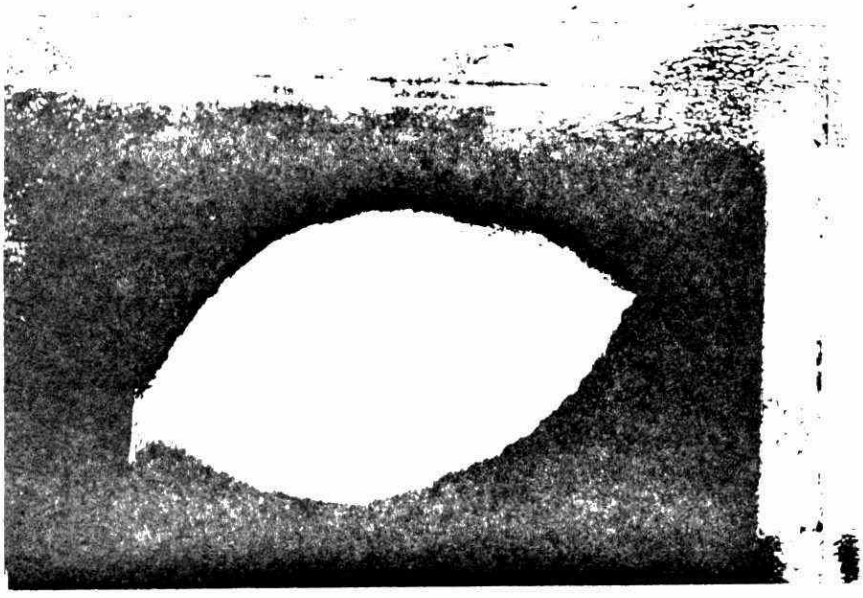
2) Place the leaves on top of the paper on a flat surface. Stroke outwards with crayon on top of the leaf onto the paper to show the detailed outline of the leaves.

Leaf Stamps

1) Place the leaves on top of the stamp pad. Put the paper directly overtop so that a silhouette will result.

2) Take the inked leaf from above and place ink-side down onto a blank sheet of paper. The 'leaf stamp' will leave its mark.





Sun Prints

Pin leaves to construction paper or hold down with small rocks, and place in bright sunlight. Let leaves remain in sun for an hour or longer. Remove leaves and find outlines on the paper. This is a very simple lesson to show that light fades colour and is a simple method to use when only the shape of the leaf is needed.

Activity: Micro-trail (young children)

Equipment

string, toothpicks

Explanation

Each child creates his own nature trail using any imaginable theme, i.e.: colours of flowers, different textures, etc. Each trail may be shown to other campers following their construction. Magnifying glass will greatly enhance this activity.

Questions may stimulate the children's imaginations. "What kind of world are you travelling through right now?" Who are your nearest neighbours? Are they friendly? Do they work hard? What would it be like to be that metallic green beetle? What is that spider going to do - eat you, or take you for a ride?

Activity: Checklist of Organisms (older children)

Materials

Checklist
Pencils

Explanation

A nature walk in the out-of-doors can reveal many interesting things. The chart shown following this section, helps children to record the many items found.

Even though we spend much of our time out-of-doors, seldom are we aware of the objects and life found there. This inventory can be used to help you discover and become aquainted with these things. Check off each item on the inventory as it is discovered.

EVIDENCE OF ANIMAL LIFE	CHECK	EVIDENCE OF PLANT LIFE	CHECK	MISCELLANEOUS OBJECTS	CHECK	MISCELLANEOUS OBJECTS	CHECK
Bird nest	____	Deciduous tree	____	Fence	____	Hill	____
Bird	____	Evergreen tree	____	Recreation Equipment	____	Grating	____
Squirrel nest	____	Flower	____	Property line marker	____	Pond	____
Squirrel	____		____	Parking lot	____	Flood Lights	____
Snake hole	____	Moss	____	Flagpole	____	Garbage Can	____
Vole Hole	____	Fungus	____	Manholes (covers)	____	Air Vents	____
Rabbit lair	____	Lichen	____	Fire hydrant	____	Fire-escape stairwell	____
Rabbit	____		____	Bicycle rack	____	Fire pit	____
Ant hill	____	Shrub	____	Utility pole	____	Historical marker	____
Bee hive	____	Hedge	____	Directional sign	____	Culvert	____
Spider	____	Climbing Vine	____	Weather Instrument	____	Erosion	____
Earthworm	____	Galls	____	Gabian Baskets	____	Bridge	____
Frog	____	Buds	____	Bird feeder	____		
Mosquito	____	Fern	____				

Going the Next Step

1. Identify at least five of the objects in the above lists and do some research on them. Your discoveries about the objects may prove very interesting.
2. Name the objects in the above lists which might have a negative effect on the health and safety of children on the grounds. Explain how children can and should be warned about the dangers they face in using or being in the vicinity of an object.
3. What types of plants would you like to have in greater abundance? What can you do to increase the number of these plants?
4. Select an object on your grounds, such as an ant hill, lichen, flower, bud, etc. and examine it daily, recording your observations of changes that occur.

Activity	Materials	Explanation
Identification		
a) Birds (older children)	Peterson Guide Identification sheets Science in Action Series - Birds	The charts following this section allow the beginner or more experienced birder to identify the species.
b) Wildflowers (older children)	Peterson Guide Identification sheets Science in Action Series - Plants	A complete study of a flower can be used as an introduction to this section. Identification can follow.
c) Animals & Tracks (older children)	Peterson Guide Plaster of Paris Science in Action Series - Mammals	This section can be incorporated into others quite easily. Plaster castings of animal tracks may enhance the activity.
d) Insects (older children)	Peterson Guide Golden Nature Guide Science in Action Series	Identification can follow the Insect Study mentioned as a separate entity in these study explanations.
e) Trees (older children)	Peterson Guide Identification sheets Science in Action Series - Woodland	This area can become quite involved. Several ideas follow.

See I.D. Guides following.

BIRD IDENTIFICATION

When bird watching, you may find that the bird does not stay in sight long enough for you to find it in an identification book. To assist you, therefore, the following data sheet has been prepared. Using the following three pages as a guide, fill in the form and then take the time to find the bird in a nature book.

DATA SHEET

SIZE A

SHAPE

General B

Bill Shape C

Tail Shape and Markings D

SIGHT

Main Color

Special Markings E

FEET F

SPECIAL HABITS

FLIGHT PATTERN

Description

Sketch

Name of Bird

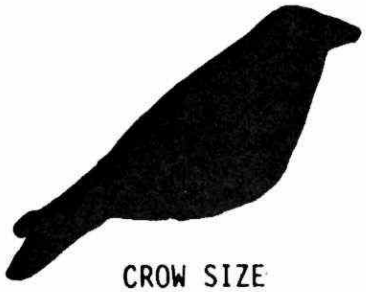
Site

Prepared by the staff of the Kingfisher Lake Outdoor Education Centre, Thunder Bay, Ontario.

A SIZE

SPARROW SIZE
5¼" TAIL TO BEAK
(13 cm)

ROBIN SIZE 8½"
(31 cm)



CROW SIZE
(43 cm)

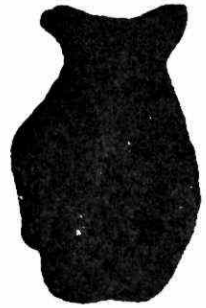
Estimate the size of the bird you are observing -- is it smaller than a sparrow? Larger than a sparrow but smaller than a robin? Express approximate size in cm.

B GENERAL BODY SHAPE

chunky as a meadow lark

plump as a grouse

slender as a swallow

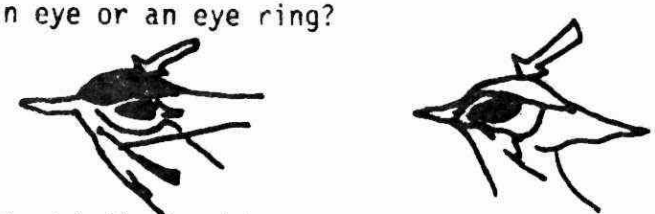


downright bulky as an owl

Does the shape of the bird that you are observing compare with any of the above? If not use words that you think describe the shape of the observed bird.

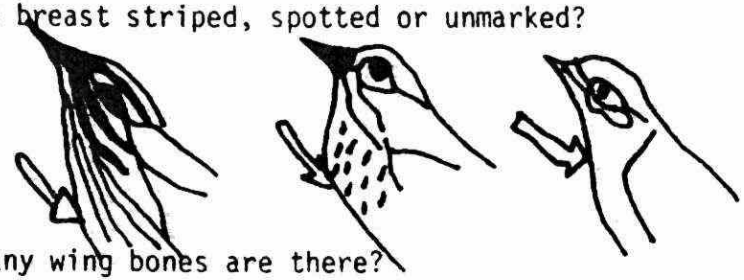
SPECIAL MARKINGS

Special Markings. Characteristic markings help in observing birds. These are known as "field marks". Does the bird have an eye or an eye ring?

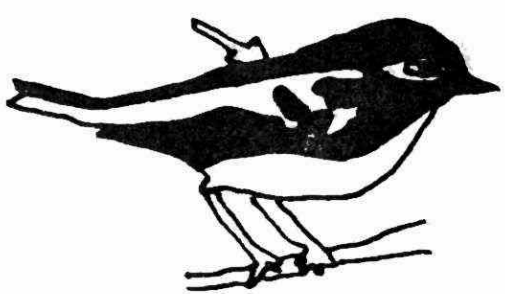


Does the bird's head have a crest, crown patch or crown stripes?

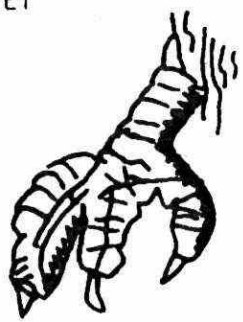
Is the breast striped, spotted or unmarked?



How many wing bones are there?

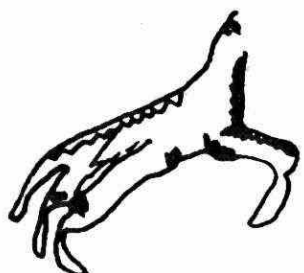


F FEET



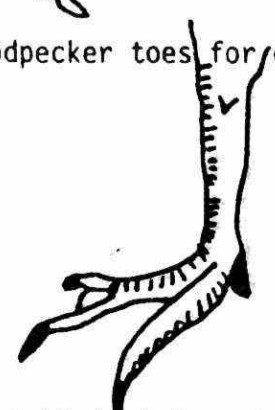
Curved claws of birds of prey.

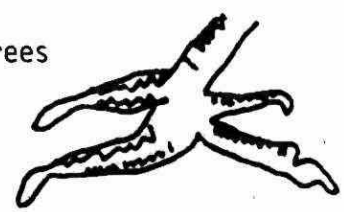
Long legs of a wading bird



Feet of a perching bird

Woodpecker toes for climbing trees



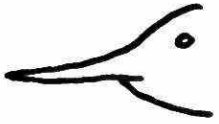


Webbed foot of a duck

What kind of feet does the bird that you are observing have?

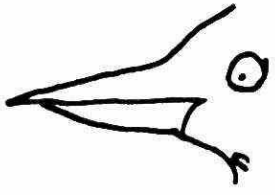
C BILL SHAPE

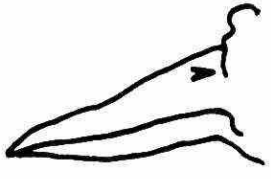
Bill of a nectar-eating bird.



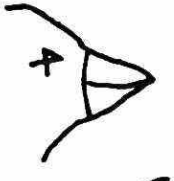
The hooked bill of the hawk is used to tear away prey.

The chisel-tipped bill of the woodpecker is used to dig insects out of the wood.

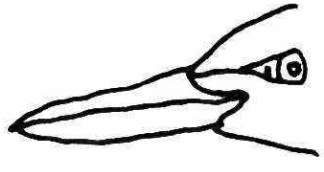




The strainerlike bill of the duck is used to sieve food from the water.



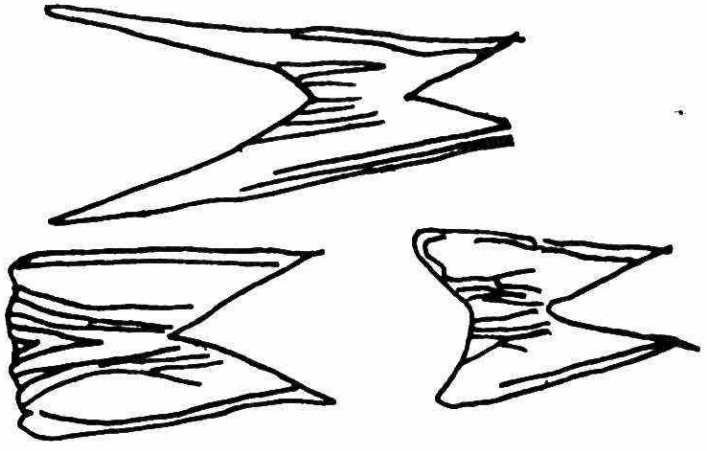
The stout, heavy bill of the seed crackers.



The spearlike bill of the heron is used to catch fish and frogs.

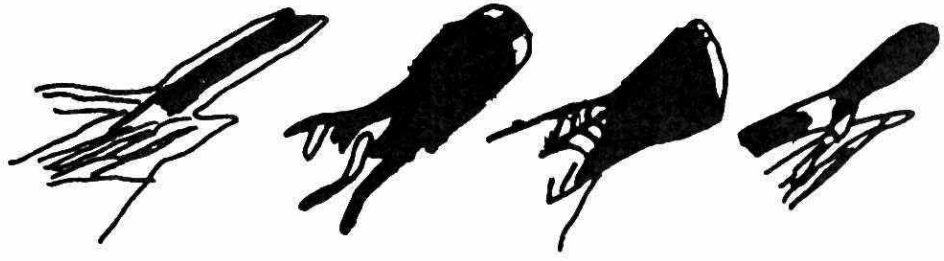
What kind of bill does the bird that you are observing have?

D TAIL SHAPE AND MARKINGS



Is the tail forked, squared or rounded? If not use other words to describe the tail.

Does the tail have



outer white tail feathers, white tail tips, tail band or colored rump patch?

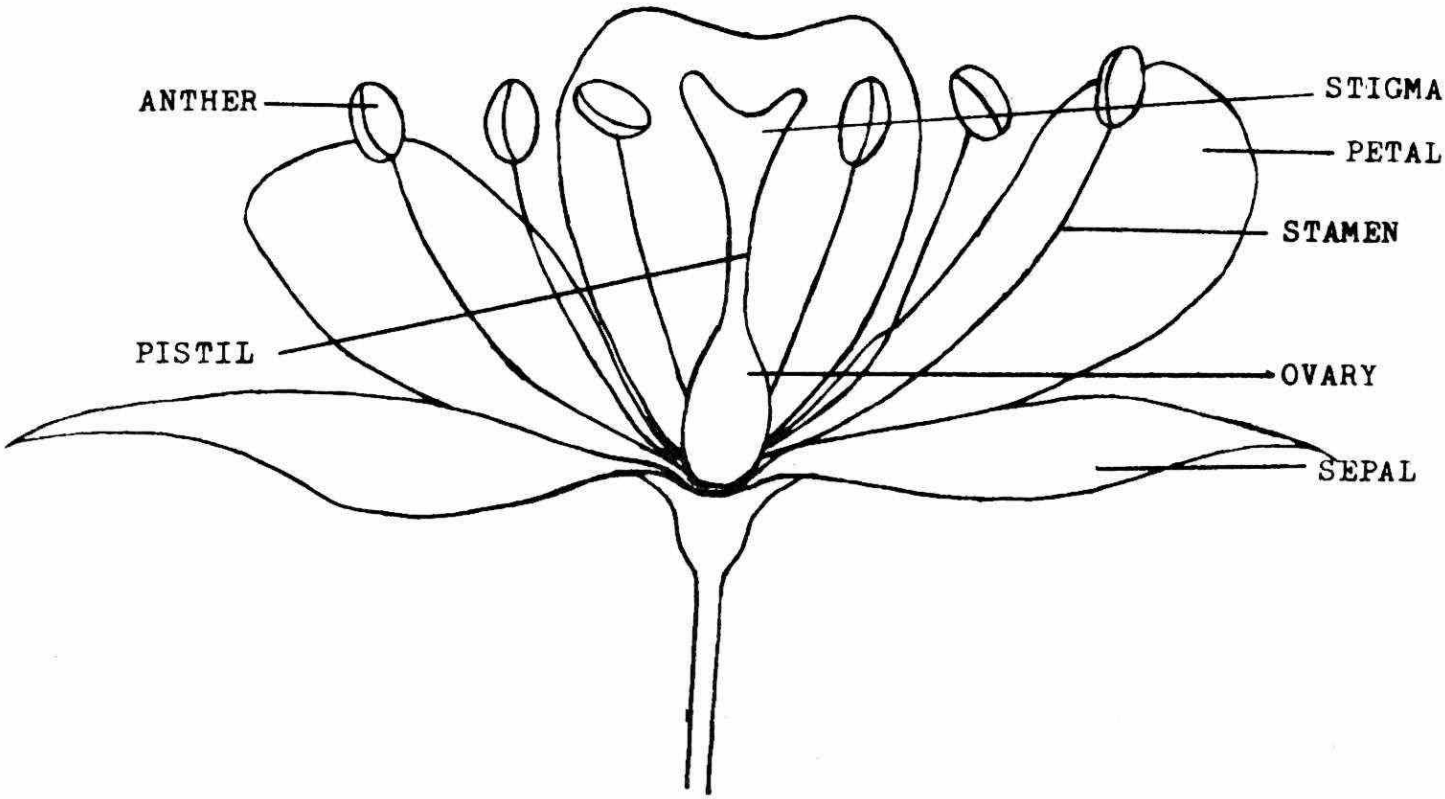
VEGETATION

Vegetation: A *pistil* is the workshop of the flower. At the bottom of each pistil is an ovary, in which tiny seeds, called *ovules*, are formed. (Some ovaries contain only one ovule.) Each ovule contains an egg cell.

When a pollen grain is transferred by insects, birds, the wind, etc. from the male part of a flower -- *the stamen* -- to the female organ -- *the stigma* -- (this is called *pollination*) the pollen grain forms a tube that grows downward to touch the egg cell in the ovule. The ovule begins to grow and develops into a seed. The seeds stay in the ovary until they are ripened and ready to be scattered by the wind, animals, water, man, or by expulsion.

Some flowers have both a pollen-bearing stigma and a pistil with an ovary. These are called *perfect flowers*. Others may have only the stamen (*male flowers*) or only the pistil (*female flowers*).

PARTS OF A PERFECT FLOWER

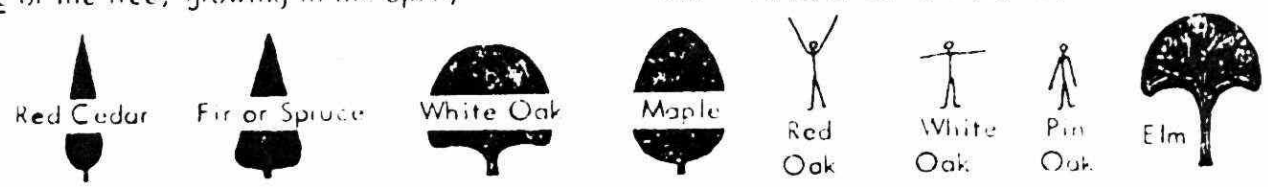


Examine various fruits (these are ripened ovaries) and locate the position and arrangement of the seeds in these fruits. For example: the seeds are on the outside of the strawberry, in the centre of the orange or grapefruit, scattered throughout the watermelon, but what about the pineapple?

TREES — AN AID TO IDENTIFICATION

Trees may be identified by shape, bark, leaf, flower and fruit (and in winter by their characteristic buds and leaf scars).

A SHAPE of the tree, growing in the open, and ANGLE OF BRANCHES



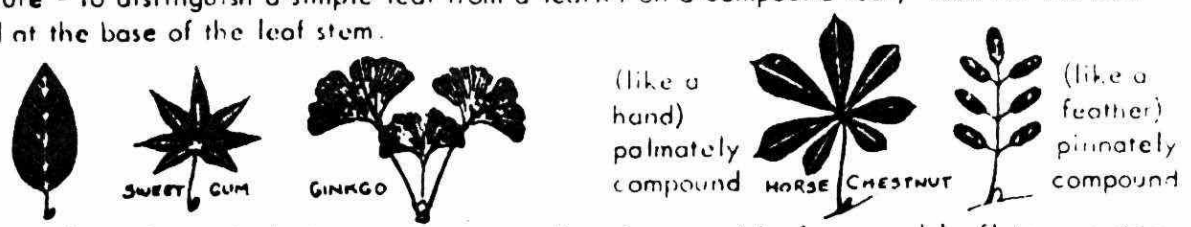
B BARK - an expert can tell trees by their bark. Examples easy to identify are:
Shaggy, in long, loose strips - Shagbark Hickory
Gray, mottled with yellow - Sycamore
White, peeling - White Birch
Light gray, smooth - American Beech

C LEAF

1. Shape - notice the edge as well as the whole shape.

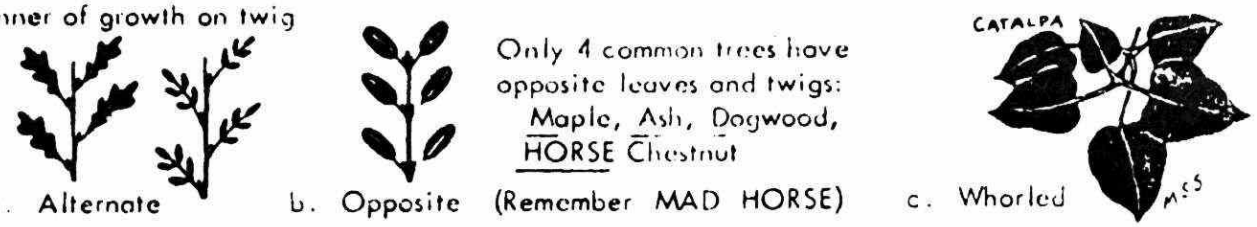
2. Texture
Leathery - Wild Black Cherry
Crisp, like a new dollar bill - Beech
Rough - Elm

3. Structure - to distinguish a simple leaf from a leaflet on a compound leaf, look for the new bud at the base of the leaf stem.



a. Simple leaf, single leaf on a stem. b. Compound leaf, several leaflets on a stem.

4. Manner of growth on twig



a. Alternate b. Opposite c. Whorled

Only 4 common trees have opposite leaves and twigs:
Maple, Ash, Dogwood,
HORSE Chestnut
(Remember MAD HORSE)

D FLOWER - all trees have flowers.
Conspicuous flowers - fruit trees and Magnolia
Lacking petals, harder to see - Elms and some Maples
Catkins - Alders, Birches, Oaks and nut trees
Many small flowers surrounded by white or colored bracts - Dogwood

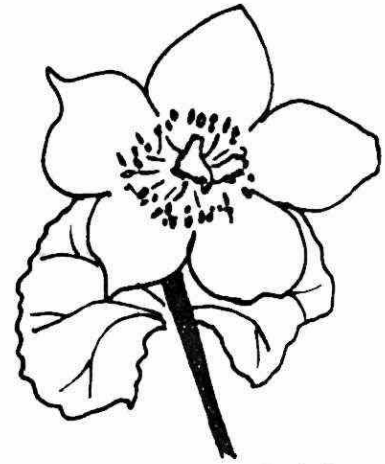
E FRUIT - the structure which follows the flower and contains the seeds.
Fleshy fruit - Apple, Cherry, Pear
Winged fruit - Maple, Elm, HopTree
Cone - Conifer
Nut - Beech, Hickory
Acorn - Oak

Ref. George A. Petrides, A Field Guide to Trees and Shrubs, Houghton Mifflin Co., 1958

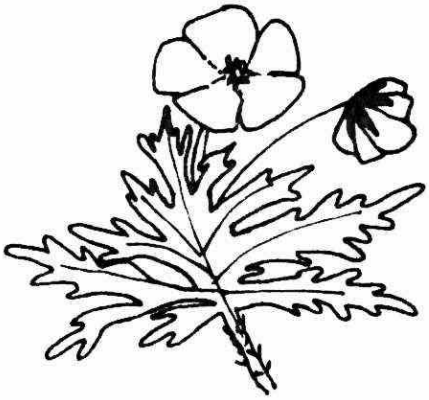
SOME COMMON PLANTS

VIOLET

LILY OF THE VALLEY



MARSH MARIGOLD



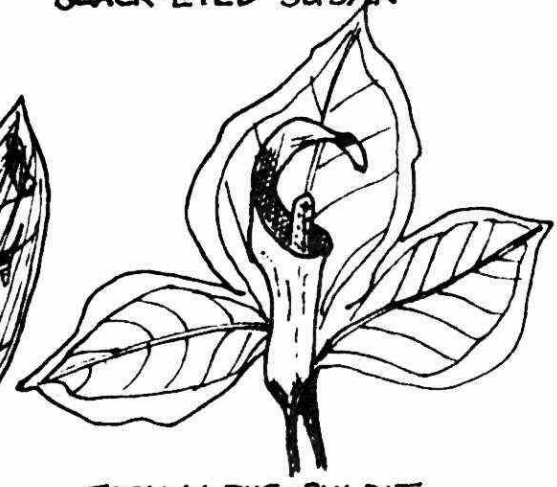
BUTTERCUP

DAISY

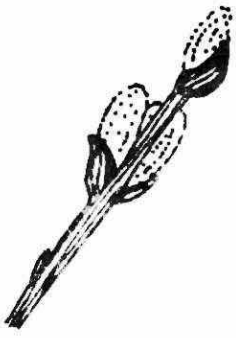
BLACK-EYED SUSAN

DUTCHMAN'S-BREECHES

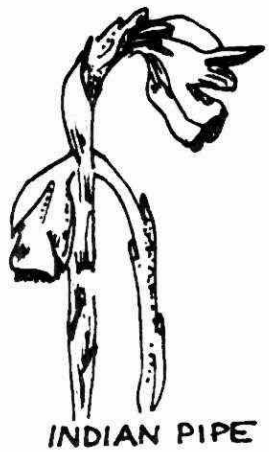
ADDER'S-TONGUE



JACK-IN-THE-PULPIT



PUSSY WILLOW

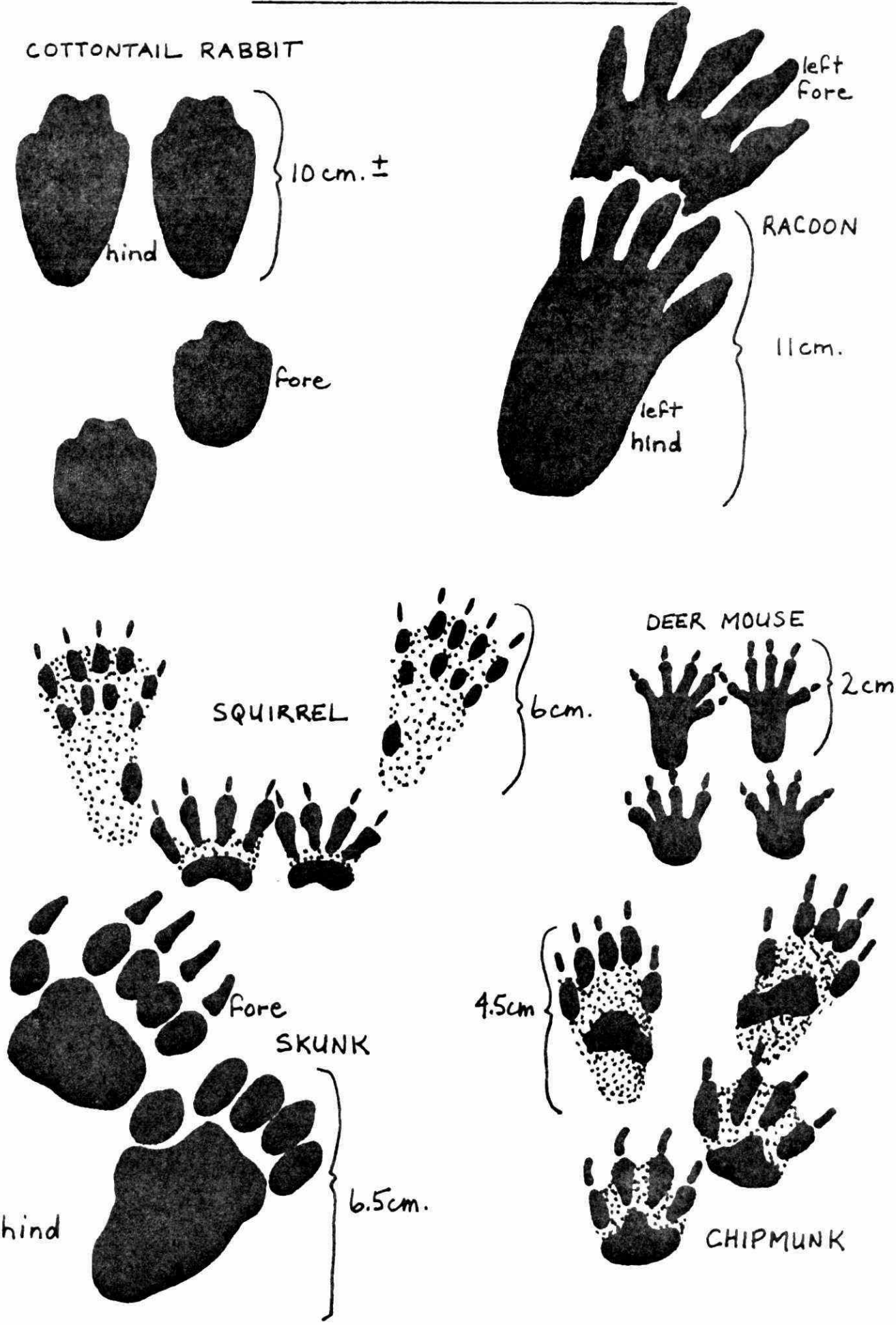


INDIAN PIPE

POISON IVY

POISON OAK

SOME COMMON ANIMAL TRACKS



TREE IDENTIFICATION

In this session, campers will be exposed to the local trees and attempt to identify them. Teams of three will work together. Each team will need some kind of an identification key. This key may be made beforehand by using a nature guide for trees and recording the common species' leaf shape, type of bark and name in a notebook. See tree classification chart.

EQUIPMENT

1. Notebook and pencil with identification guide (one for a group).
2. A metre long stick (one per group)
3. Compass (one per group:optional)

PROCEDURE GUIDELINES

Two different approaches can be used in this study depending primarily on the availability of compasses.

Method 1:

If you are not able to use compasses, you will have to spend some time before the activity begins, marking trails.

To mark a trail use bright colored ribbons or string. Tie them around trees leaving about 6 to 8 metres between each one. (The reason the trees need to be marked is so the campers can walk in a straight line heading in a chosen direction, for example, north. The direction will be decided upon beforehand by the leader who will also give the campers a location to stop, say, for example, when you reach the corn field or the cow pasture.) The team heads out with the navigator in front looking for the marked trees. The stick person follows behind holding a stick horizontally at waist height, stopping every time the stick hits a tree. He/she yells "stop" and the navigator and the recorder go to the tree and, using the key, identify it. The recorder records the name in the notebook. The number of marked trails will depend on how many are participating in the study. Separate the groups by at least 6 metres to avoid distractions and confusion. Try to arrange that each group has to identify approximately the same number of trees.

Method 2:

When using compasses, the navigator keeps the team walking in a straight path, in the pre-selected direction, by following the pointer on the compass. The stick person and recorder follow and proceed as outlined in Method 1.

In the case of a tree which cannot be identified, one leaf may be taken or a picture of it drawn in the notebook to be examined at the end of the outing by the leader.

Often a certain species will be very abundant in a woodlot with the team constantly recording it. In this case, the most abundant and dominant species will be discovered. Have the recorder check off the tree even if it has been previously recorded so that the total number may be added up at the end of the activity.

With older campers the diameter of the trees may be taken by using a tape measure, ruler or with a piece of string with known divisions marked off on it. From this information, the students will get some indication of the ranges in size and therefore the different ages of the trees.

At the end of the study the teams can tell their results to the others. A discussion on why some groups did not find the same trees may result.

An ideal study would involve the campers being exposed to roughly ten different species.

ADDITIONAL ACTIVITIES

1. Examine the area below a tree for seeds or young saplings. How did they get there? Are the young trees of the same species?

2. Locate a tree stump and study the growth rings. Why are some rings further apart than others? Why would a tree grow faster and larger only in some years? What does a tree need to stay alive?

3. Climb a tree. Be careful not to break off many branches. Can you feel the tree move when you are in it? Why is it moving?

TREE CLASSIFICATION CHART

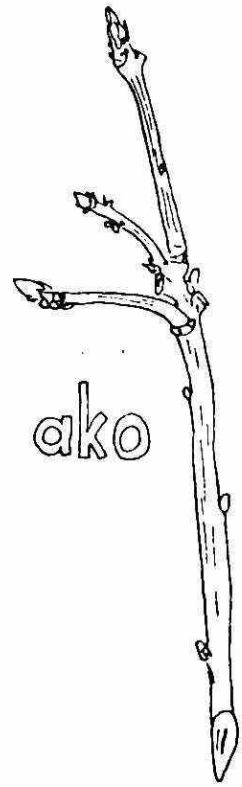
By carefully recording the different characteristics of the trees you find and then looking up the name in a guide book when you return home, you can learn to distinguish one tree from another. This form could also be filled in by children before a field trip and used as an identification chart. In this case, however, the adult should list the names of the trees that may be found in the area.

Shape	Bark	Leaves	Buds	Flower	Fruit	Outstanding Features	Name
 limbs reach upwards	Vertical light and dark	 pointed tips	In a cluster and pointed 	Long drooping cattails 	Acorn 	Shallow acorn cap longish nut	Red Oak
	Peeling scaly		Large egg shaped 		Nut 	Shaggy bark	Shaggy bark hickory
							Sugar Maple
							Birch

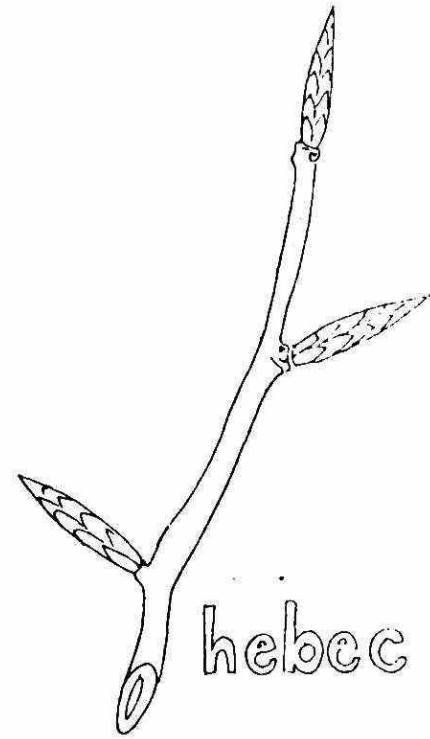
Note: Obviously, the seasons will influence which columns can be filled in.

Do you know these twigs?

theiw sah



wehti ako



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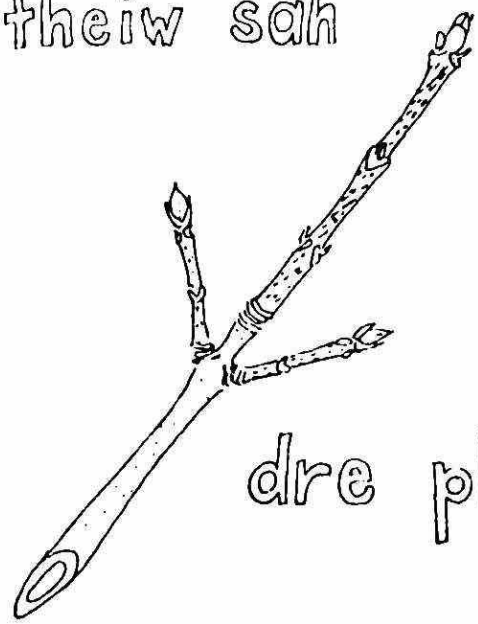

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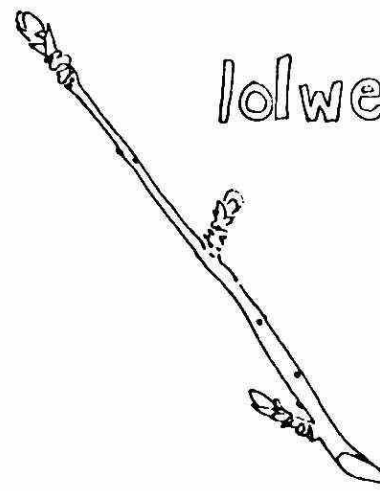
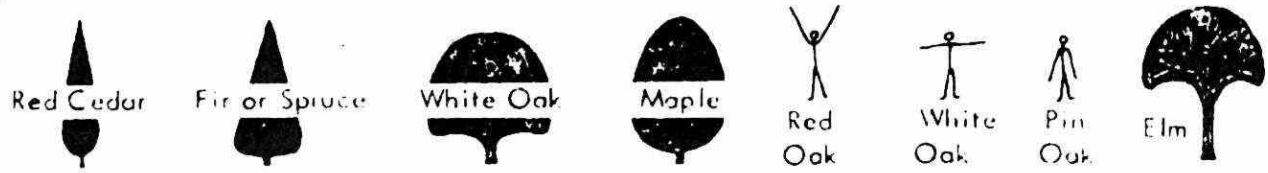


lolwey rhicb

TREES — AN AID TO IDENTIFICATION

Trees may be identified by shape, bark, leaf, flower and fruit (and in winter by their characteristic buds and leaf scars).

A. SHAPE of the tree, growing in the open, and ANGLE OF BRANCHES



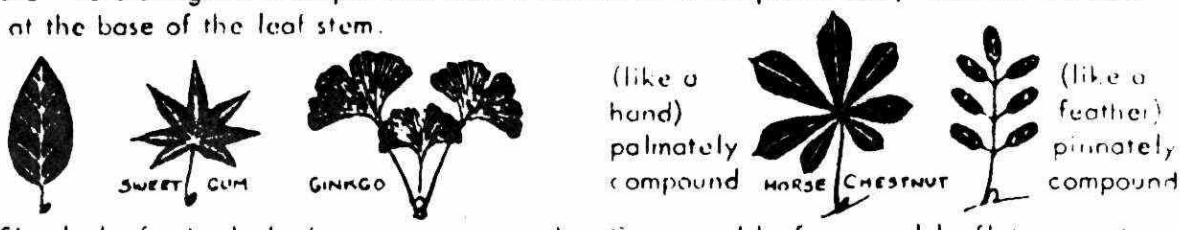
B. BARK - an expert can tell trees by their bark. Examples easy to identify are:
Shaggy, in long, loose strips - Shagbark Hickory
Gray, mottled with yellow - Sycamore
White, peeling - White Birch
Light gray, smooth - American Beech

C. LEAF

1. Shape - notice the edge as well as the whole shape.

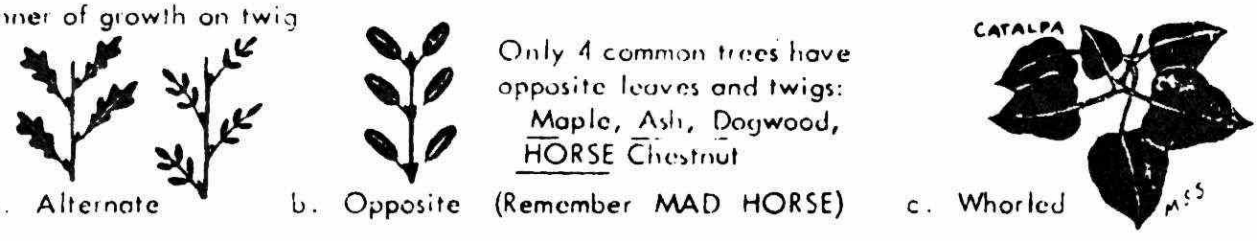
2. Texture
Leathery - Wild Black Cherry
Crisp, like a new dollar bill - Beech
Rough - Elm

3. Structure - to distinguish a simple leaf from a leaflet on a compound leaf, look for the new bud at the base of the leaf stem.



a. Simple leaf, single leaf on a stem. b. Compound leaf, several leaflets on a stem.

4. Manner of growth on twig



Only 4 common trees have opposite leaves and twigs:
Maple, Ash, Dogwood, HORSE Chestnut

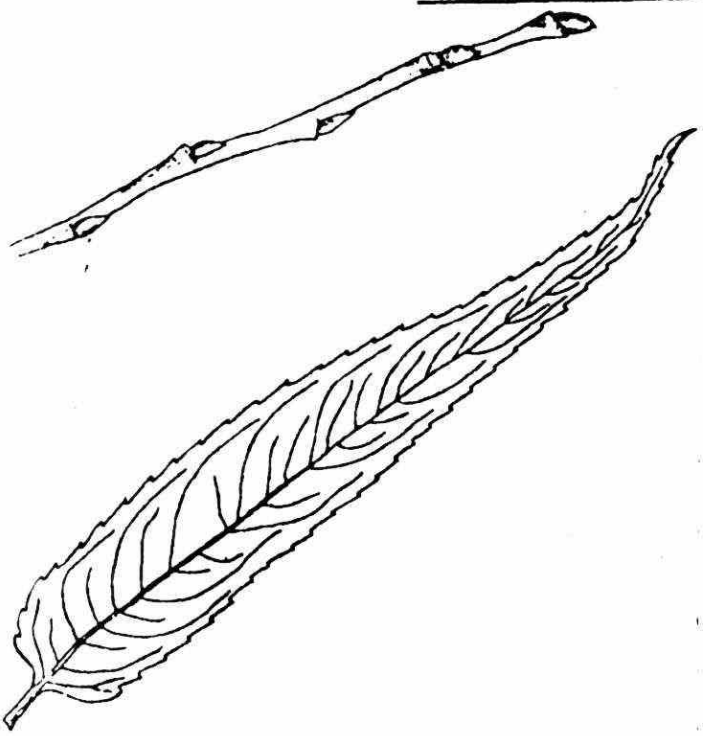
a. Alternate b. Opposite (Remember MAD HORSE) c. Whorled

D. FLOWER - all trees have flowers.
Conspicuous flowers - fruit trees and Magnolia
Lacking petals, harder to see - Elms and some Maples
Catkins - Alders, Birches, Oaks and nut trees
Many small flowers surrounded by white or colored bracts - Dogwood

E. FRUIT - the structure which follows the flower and contains the seeds.
Fleshy fruit - Apple, Cherry, Pear
Winged fruit - Maple, Elm, HopTree
Cone - Conifer
Nut - Beech, Hickory
Acorn - Oak

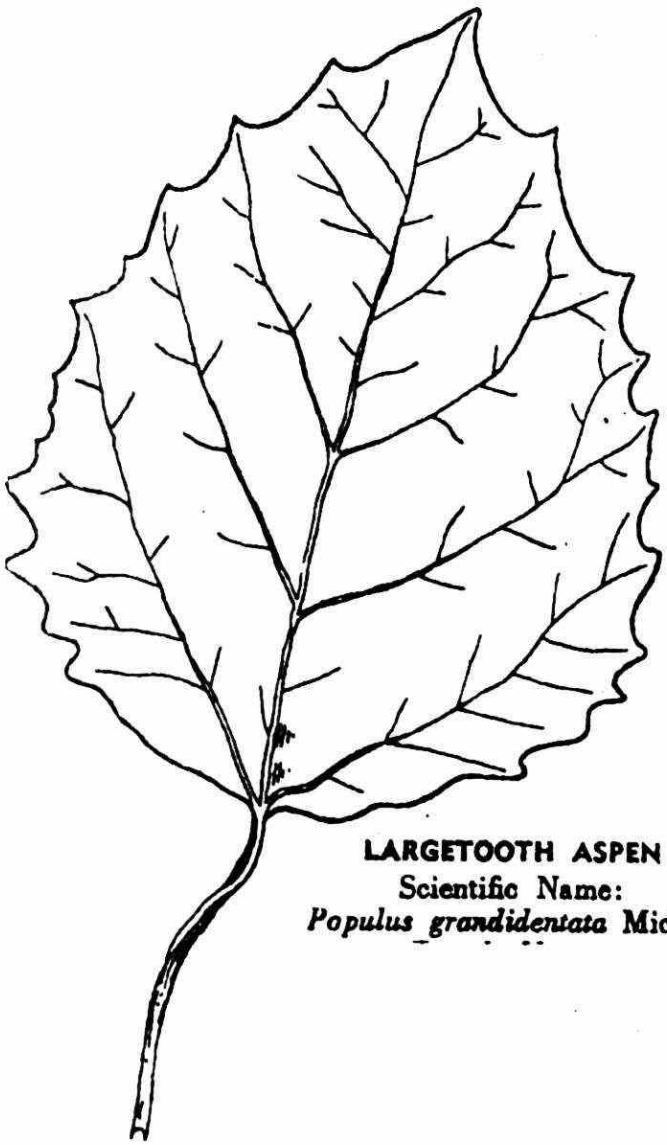
Ref. George A. Petrides, A Field Guide to Trees and Shrubs, Houghton Mifflin Co., 1958

SOME COMMON TREES OF ONTARIO...



BLACK WILLOW
Scientific Name: *Salix nigra* Marsh.

TREMBLING ASPEN
Scientific Name: *Populus tremuloides* Michx.



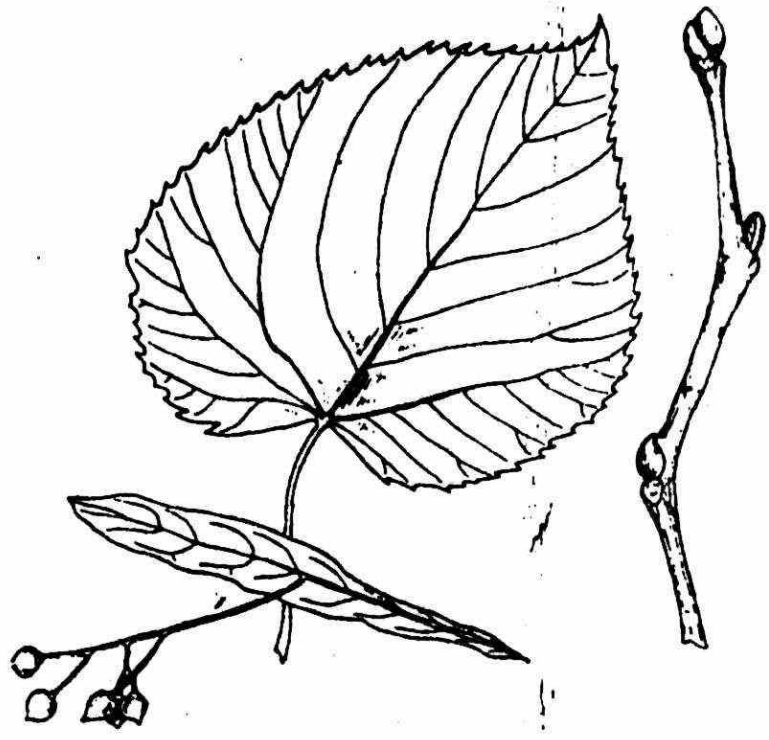
LARGETOOTH ASPEN
Scientific Name:
Populus grandidentata Michx.

BALSAM POPLAR
Scientific Name: *Populus balsamifera* L.

BEECH

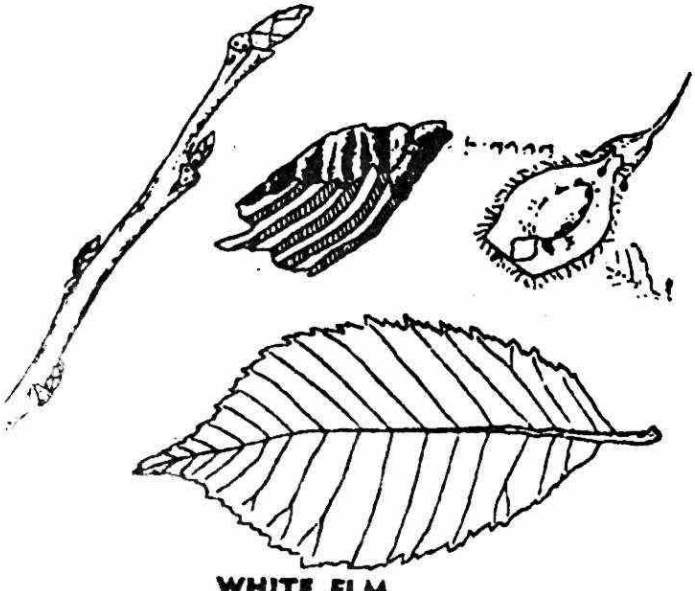
Scientific Name: *Fagus grandifolia* Ehrh.

- the bark is smooth and gray.
- the thinness of the bark makes it susceptible to cracks caused by frost.



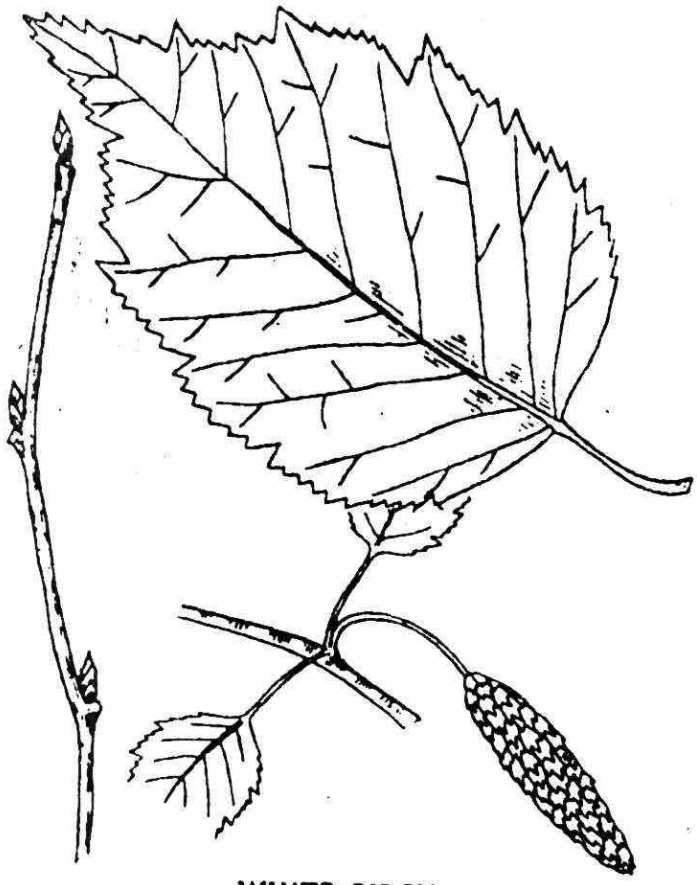
BASSWOOD

Scientific Name: *Tilia americana* L.

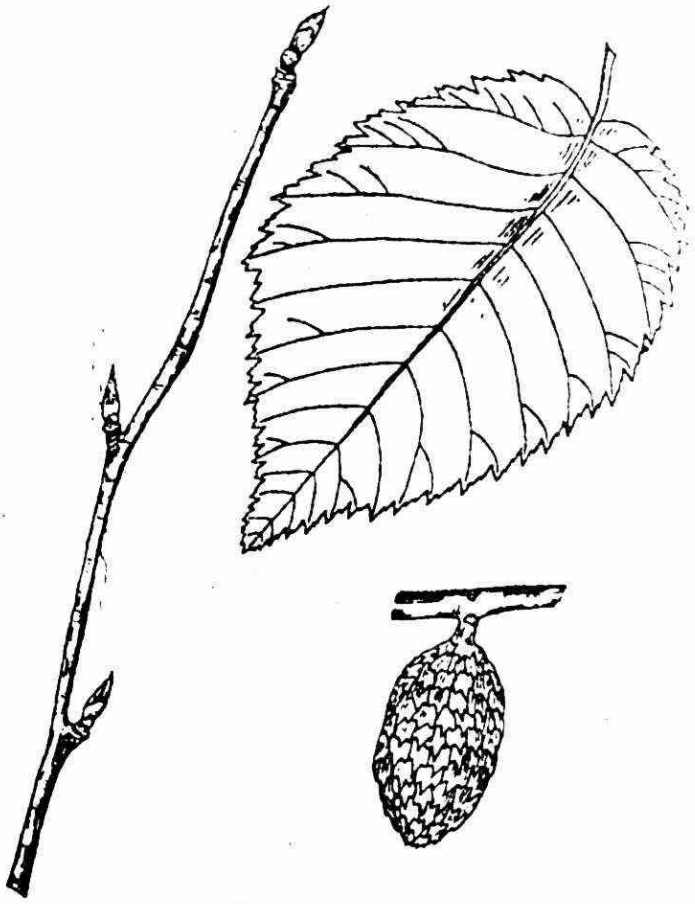


WHITE ELM

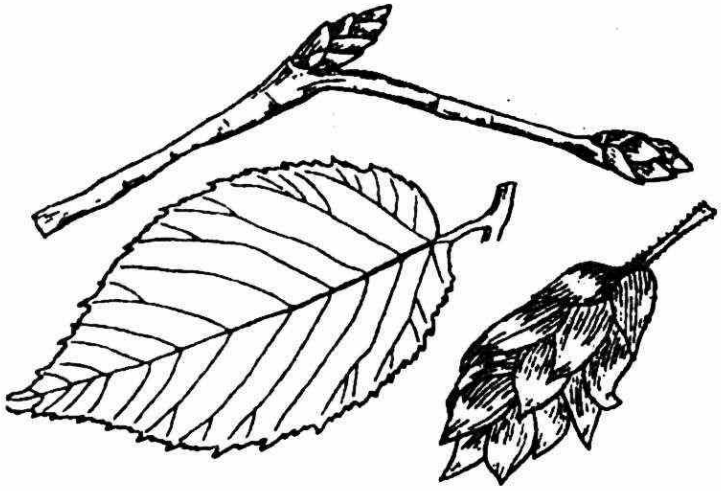
Scientific Name: *Ulmus americana* L.



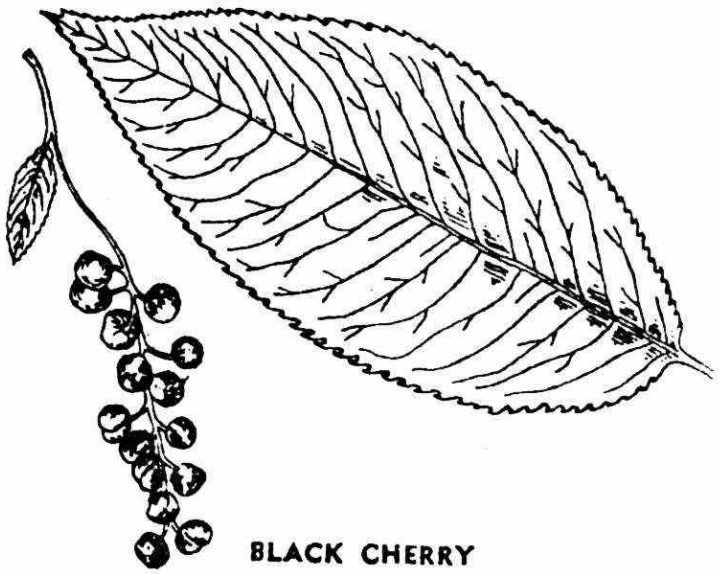
WHITE BIRCH
Scientific Name: *Betula papyrifera* Marsh.
- has white, paper-like bark.



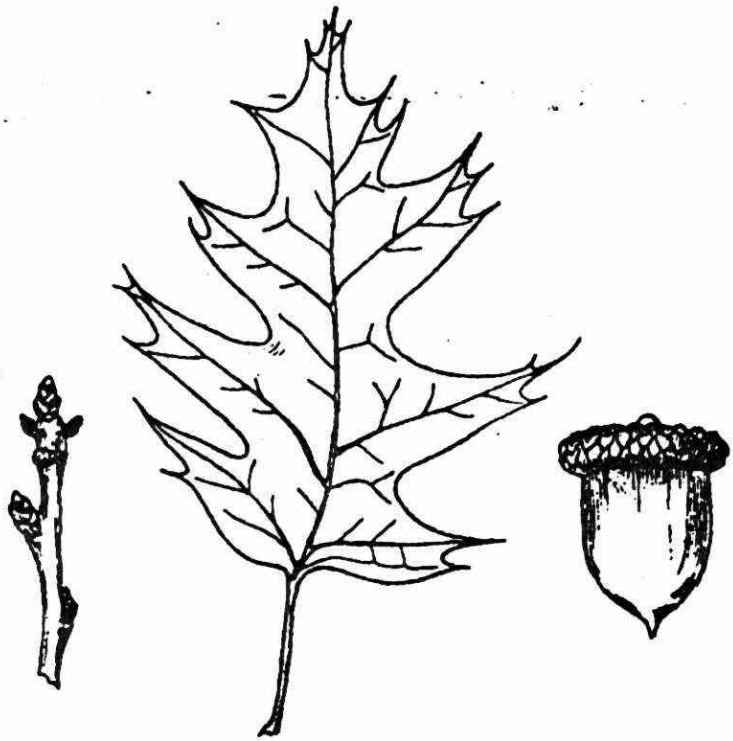
YELLOW BIRCH
Scientific Name: *Betula lutea* Michx. f.
- young twigs taste like wintergreen
- has yellow, paper-like bark.



IRONWOOD (Hornbeam)
Scientific Name: *Ostrya virginiana* (Mill.) K. Koch
- very difficult to cut due to the denseness of the wood, and also to carry!



BLACK CHERRY
Scientific Name: *Prunus serotina* Ehrh.
-highly prized for furniture making.



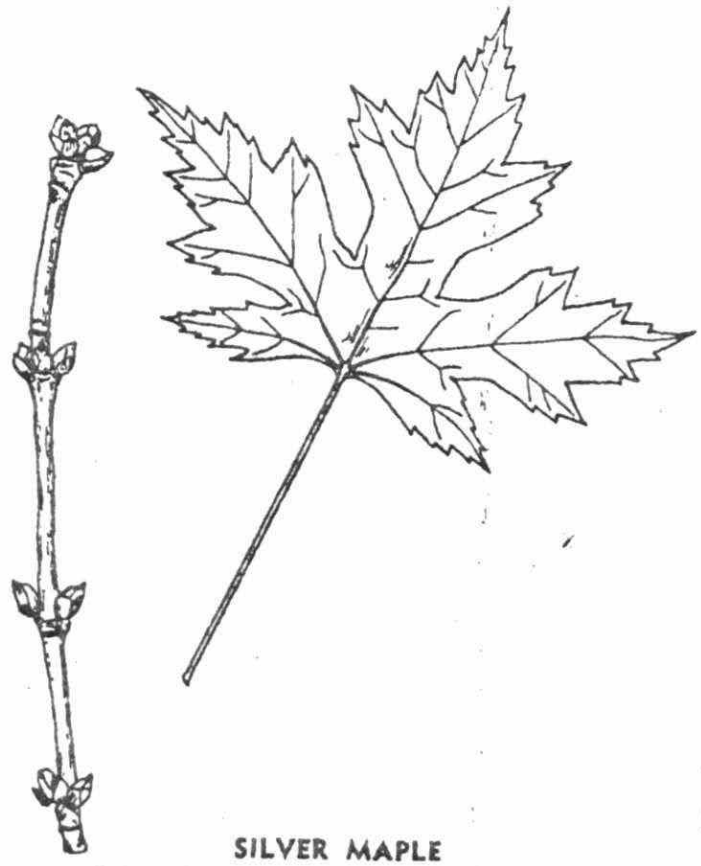
RED OAK
Scientific Name: *Quercus borealis* Michx. f.

WHITE OAK
Scientific Name: *Quercus alba* L.

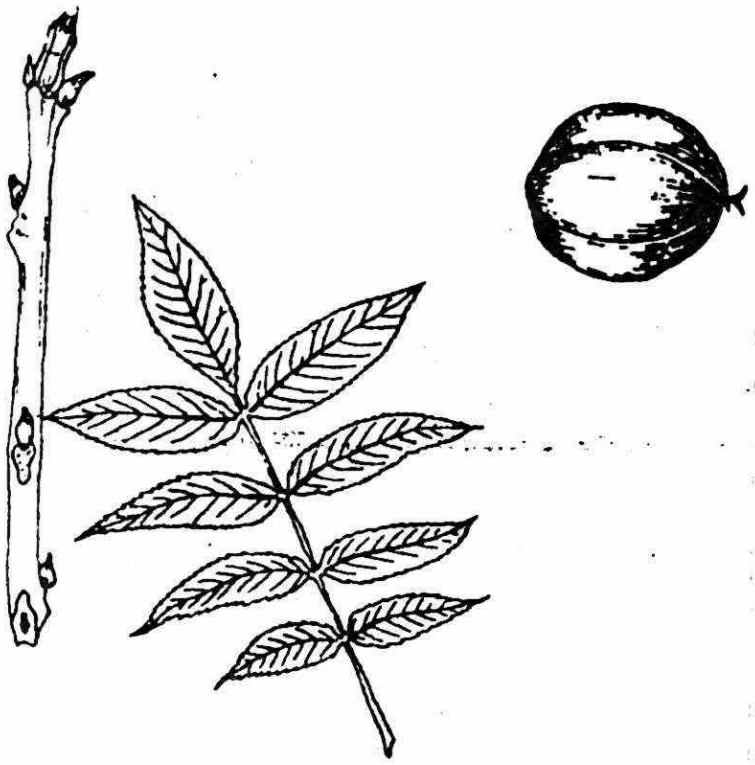
SUGAR MAPLE (Hard Maple)
Scientific Name: *Acer saccharum* Marsh.
- sap is used to make maple syrup.

RED MAPLE
Scientific Name: *Acer rubrum* L.

- sap is used to make maple syrup.



SILVER MAPLE
Scientific Name: *Acer saccharinum* L.

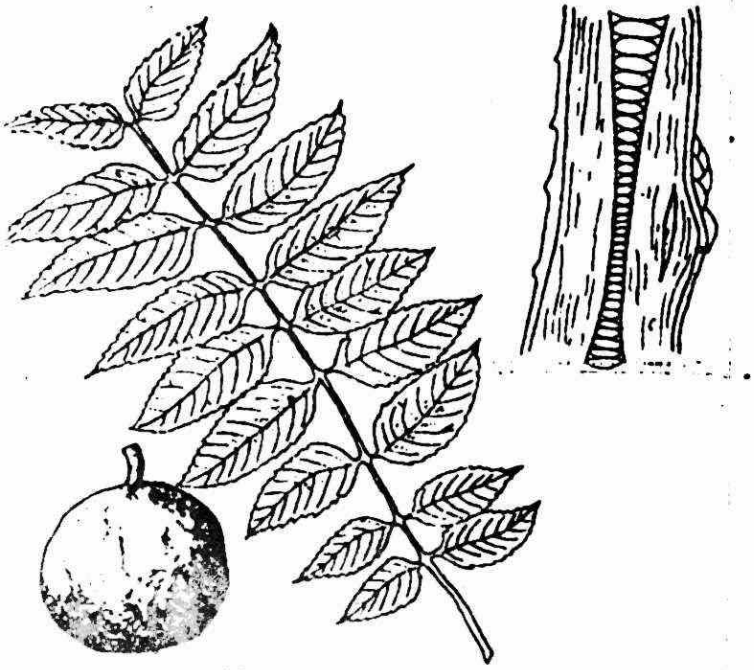


BITTERNUT (Sulphur-bud) HICKORY
Scientific Name: *Carya cordiformis* (Wangh.) K. Koch

- note the compound leaf

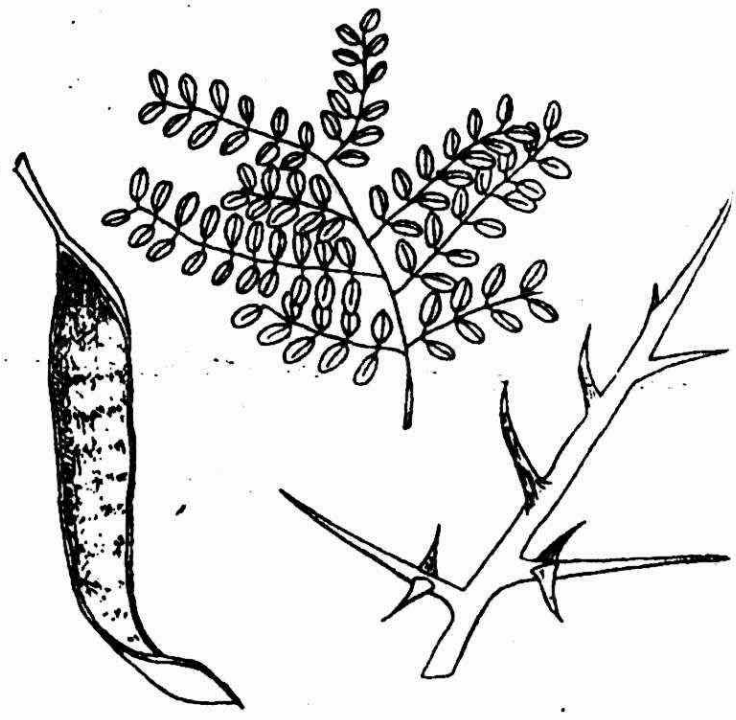
WHITE ASH
Scientific Name: *Fraxinus americana L.*

- note the compound leaf
- the wood is very flexible



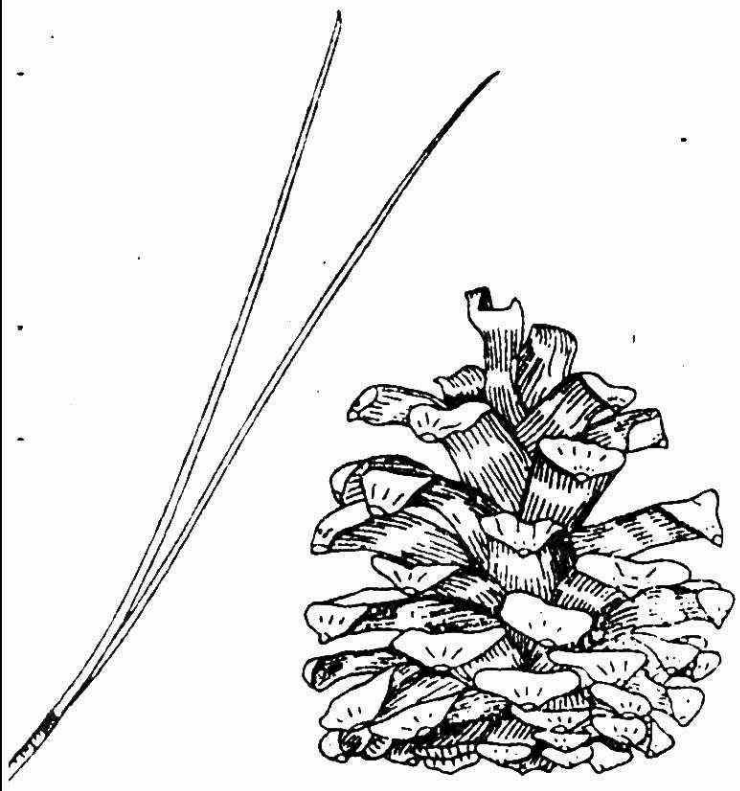
BLACK WALNUT
Scientific Name: *Juglans nigra* L.

- note the compound leaf
- the wood is highly prized for furniture-making.



HONEY LOCUST
Scientific Name: *Gleditsia triacanthos* L.

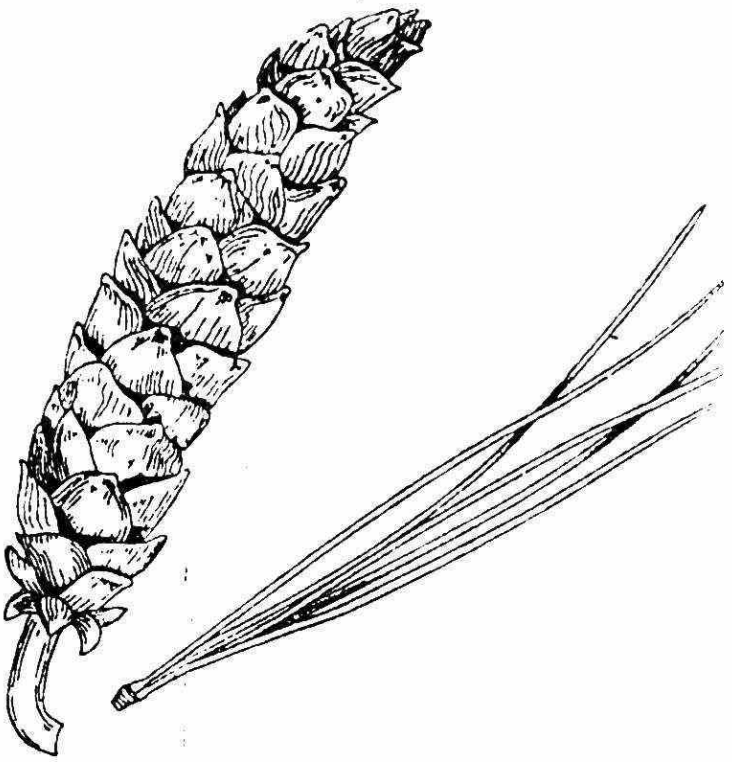
- note the compound leaf



RED PINE

Scientific Name: *Pinus resinosa Ait.*

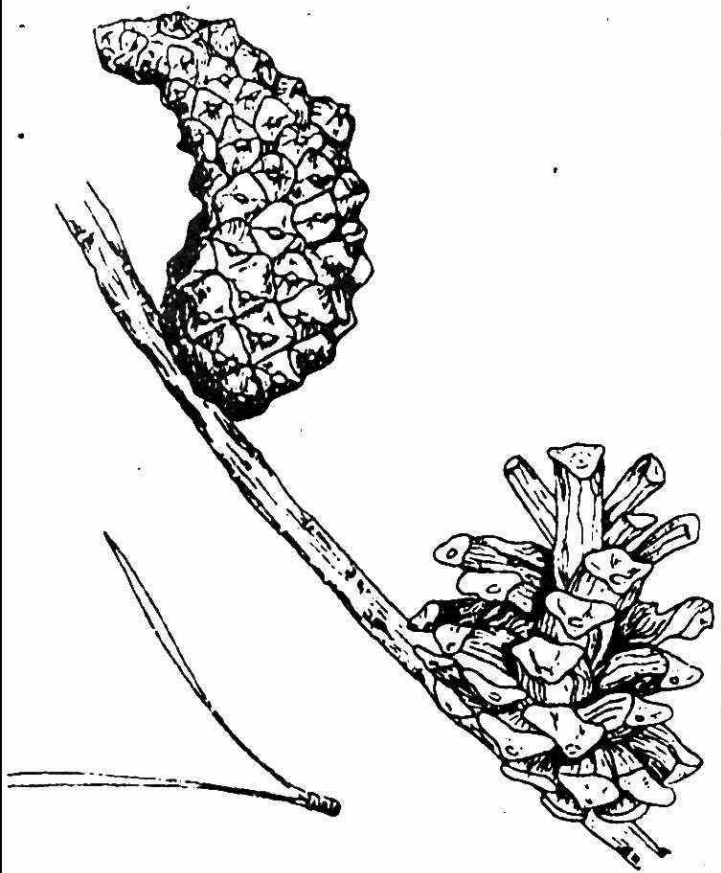
- red, flakey bark.
- two needles per bundle.



WHITE PINE (Eastern)

Scientific Name: *Pinus strobus* L.

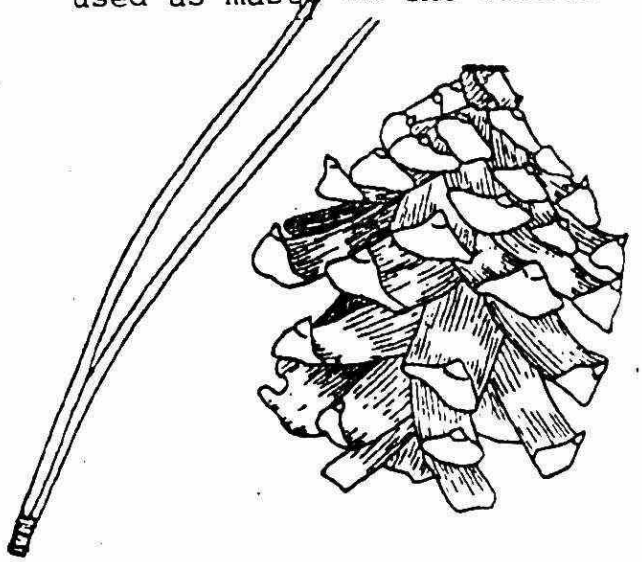
-5 soft needles per bundle.
-softness of needles casts a feathery look to this tree.
-in the late 1800's and early 1900's, white pine was the major timber source. At one time, these huge trunks were used as masts on the wooden ships



JACK PINE

Scientific Name: *Pinus Banksiana Lamb.*

- twisted needles
- cone opens only under extreme heat,

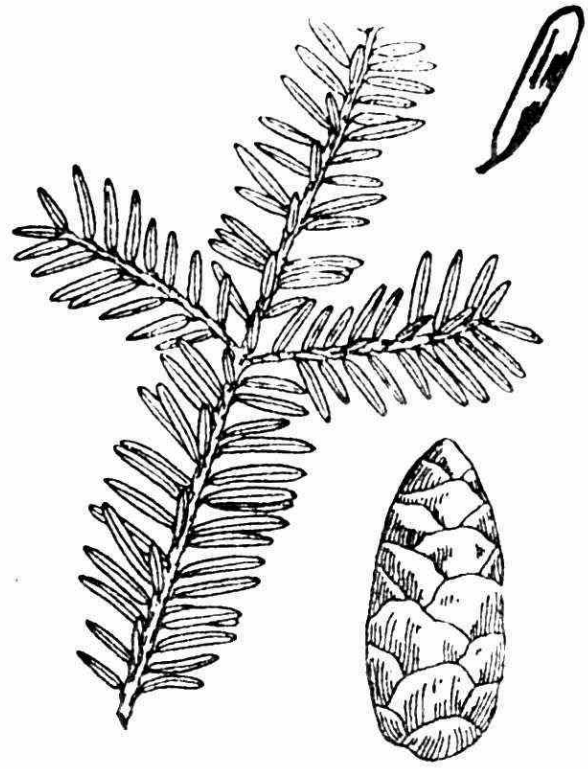


SCOTCH PINE (Not Native)

Scientific Name: *Pinus sylvestris L.*

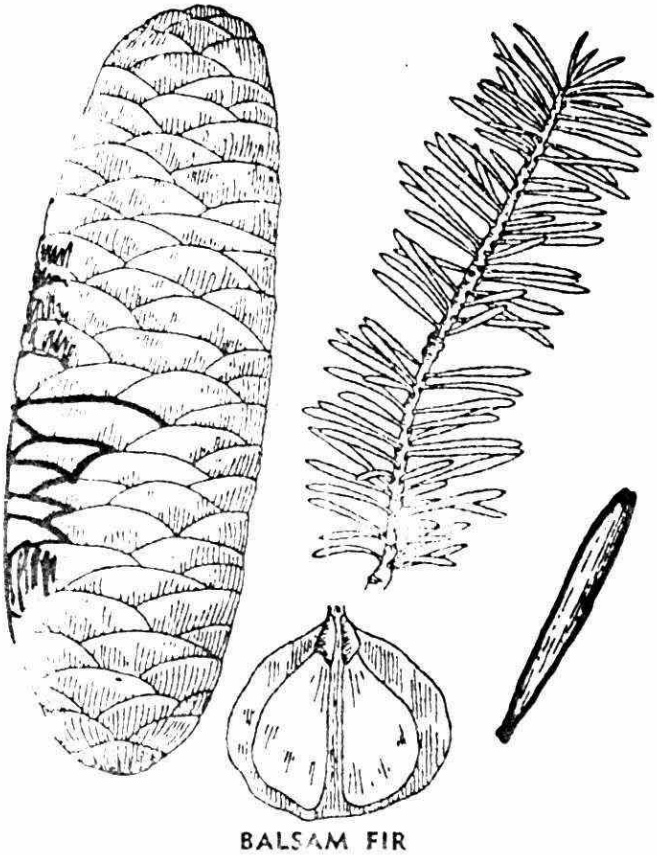
- bark is orange towards the top of the tree.

WHITE CEDAR (Eastern)
Scientific Name: *Thuja occidentalis L.*



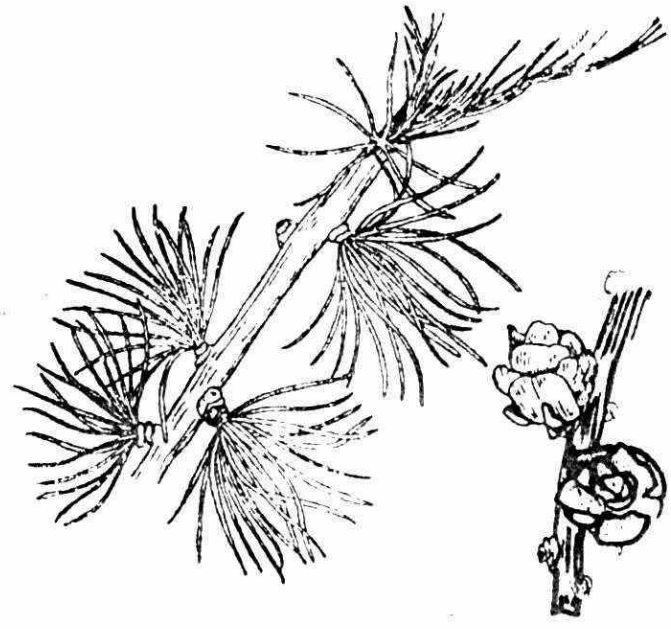
HEMLOCK (Eastern)
Scientific Name: *Tsuga canadensis L. Carr.*

- needles have a short stalk.
- needle length: approx. 1 cm.



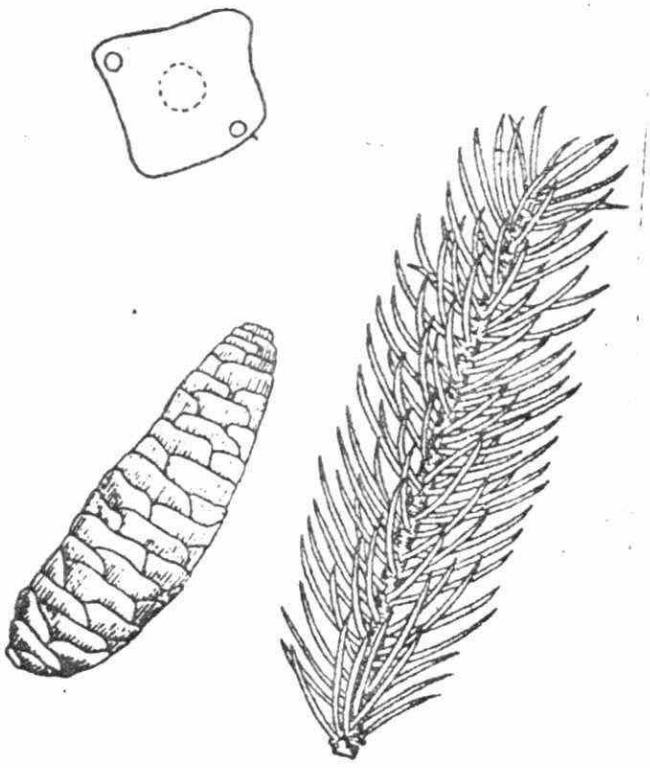
BALSAM FIR
Scientific Name: *Abies balsamea (L.) Mill.*

- no stalk
- needle length: 1.5 - 2. cm
- notch in the apex of needle.

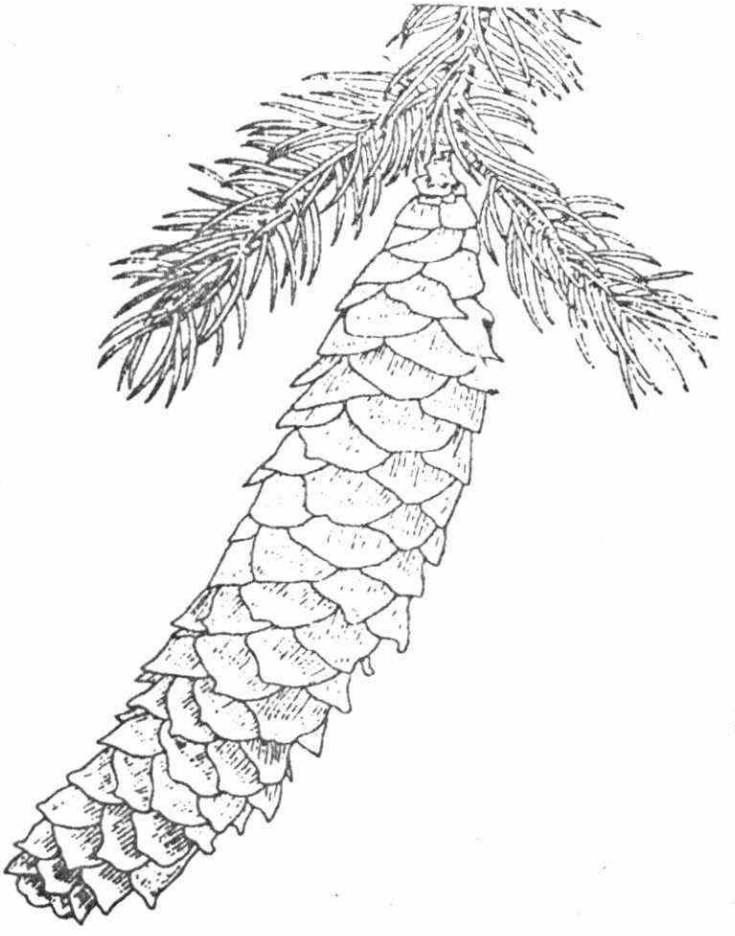


TAMARACK
Scientific Name: *Larix laricina* (Du Roi) K. Koch

- needles fall off in winter--
a deciduous conifer.



WHITE SPRUCE (Eastern)
Scientific Name: *Picea glauca* (Moench) Voss



NORWAY SPRUCE (Not Native)
Scientific Name: *Picea abies* (L.) Karst.

Activity: Animal Lobbyists (older children)

MANY PEOPLE judge the value of a plant or animal solely by the way it affects man. But all plants and animals make important contributions to their fellow life forms, thereby benefitting the entire cycle of life. The riddles below help us understand how the animals and plants that we normally might consider pests actually contribute to the welfare of the whole.

Below each riddle you will see a row of letters. To decode the answer, write down, for each letter in the line, the letter that follows it in the alphabet.

Example: B N V=C O W.

Riddles:

Since we can do only the work Mother Nature has given us, we wish humans would be a little more understanding when we mistakenly go to work in their towns. If we stopped our forest labors, humans would soon see the value of our work; for the very thing they are trying to protect would soon be denied them. We reduce fallen trees to humus by our eating habits, making soil nutrients once again available for plants and trees to grow on.

S D Q L H S D R

I do my part to control the rodent population. This greatly benefits the plant world and helps the farmer, too. Nevertheless, most of you humans don't like me and fear me. What you don't realize is that I'm just as afraid of you as you are of me. It would reduce tensions a lot if you would watch where you put your feet. If I think you're about to step on me, I'll let you know where I am.

Q Z S S K D R M Z J D

I am a very important part of nature. I am a valuable source of food for many kinds of birds. It is worthwhile for humans to be able to recognize me, especially in the Spring. My leaves are grouped in threes and sometimes are very oily and reddish in color. You may recall our meeting – if afterwards some itchy, red spots appeared on your skin.

O N H R M M N Z J N Q H U X

Many kinds of fishes and birds depend on me for their food. Without me, there wouldn't be as many animals inhabiting the sky and water as there are now. Unfortunately, I do carry disease and can spread it to man. I fly slowly, especially after I've just eaten. Only the females of my kind will bite you.

L N R P T H S N

Although I'm shy, I'm very patient in my work, and I can be quite creative. I work seasonally outdoors, but year-round indoors. I work hard to clean your house of pesky critters, but I don't like it when I'm mistaken for one of those critters myself! If it weren't for the few cousins who give us a bad name, humans would have greater respect and appreciation for our honorable family.

R O H C D Q

From Sharing Nature With Children, Joseph Cornell

Letter Jumble (for older children)

The names of 20 trees can be found among these letters. The name of the tree is read forward, backward, or diagonally. One letter can be used for more than one tree. Draw a circle around the name of the tree when you find it.

A M K A B Q R E A P P L E A T
T U L I P A S D F B A S B O S
B L M Z C E D A R E B U Q C R
C B N Y S P R U C E C M R D Q
W E W A L N U T G C D A S C P
H R O X C O T M O H E C T H O
I R C H O K E C H E R R Y E N
T Y P I D M U W I L L O W R M
E J Q C E A S H J M F P U R L
P I R K O A K B E R A N V Y K
I H S O F M V A I M G S W E J
N G T R G L A Z K Q L M P F I
E F U Y H K W P M I H O X E H
C H E S T N U T L O I L C Z N
D E V W I J X Y N E J K Y K G

TREES

Elm
Chokecherry
Apple
Spruce
Willow
Beech
Oak
Hickory
Tulip
Hemlock
Ash
White Pine
Maple
Mulberry
Sumac
Cherry
Chestnut
Walnut
Cedar
Aspen

trees

Activity: Nature Books (all ages)

Equipment

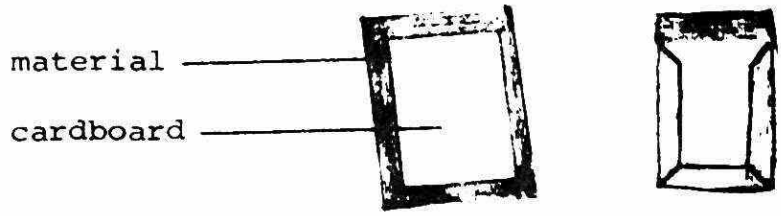
scissors
corrugated cardboard
material or wallpaper, mactac
heavy-duty tape
8"x11" completed sheets
stapler
glue

Explanation

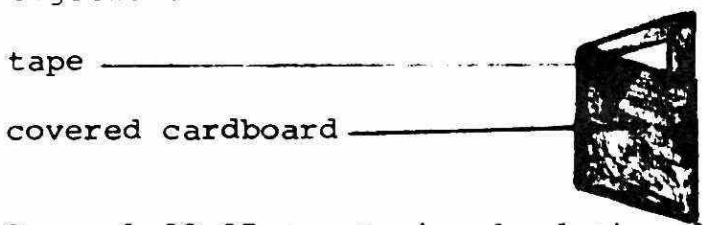
This activity should be started at the beginning of the nature unit, so that the children may add to it as they progress through time.

Construction:

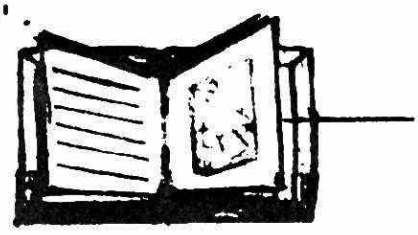
Cut two pieces of 17.5x22 cm corrugated cardboard from a packing box. Pieces of material, wallpaper from old books, or mactac sheets, 22x30 cm in size can be cut and glued to the cardboard pieces.



Heavy duty tape is then used to tape the two book covers together.



Several 20x27 cm previously designed sheets of paper are then folded in half and stapled together along the centre line. These are the pages of the book. To secure the pages to the cover, one sheet on each side is glued to the inside cover of the 'book'.

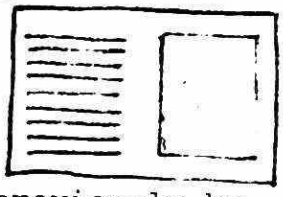


The book is now ready for use.

Construction of pages of the book:

Several activities can be recorded through-out the camping period. Some examples are:

1) Polaroid picture shots
2) Stories or poems about nature walks or activities*
3) Leaf rubbings or stamps
4) Study sheets from other environmental studies*
5) Cut-out pictures from nature magazines.
6) Pressed plants or leaves.
7) Animal prints
8) Sketches in the outdoors



*For any written material, sheets can be lined previously by photocopy machines or dittos.

It is suggested that the counsellor or instructor keep an ongoing file for the childrens work so that it does not get soiled or lost in the process of the camping period.

The first page of the book consists of the title page with the title, author(camper), publisher(camper) and copyright(date made). Following this are pages for

1) A dedication
2) A table of contents.

The rest of the pages may be filled with work the children have done with an autograph page at the back.

Activity: Nature Hunt (all ages)

Equipment

printed sheets
pencils

Explanation

These are scavenger hunts where the children must use their imagination to find various articles in nature according to a basic master plan. Examples of these follow this section.

Instructions:

Merely fill in the sheets provided. (See following pages)

Follow-up Activities:

1) Alter the hunt. Examples:

a) General Hunt -find a seed that travels by wind
-find soil that feels like clay
-find an animal home
-find an insect on a plant
-find a leaf with parallel veins
-find Ontario's Provincial flower etc.

b) Animal-Food Hunt -find food for a bird
squirrel
insect
snail
frog etc.

c) Natural Shape Hunt -find objects that have these shapes:

d) Riddled Hunt -find a tree that barks (Dogwood)
-find a tree used to make maple syrup (Maple)
-find a tree that was used to make canoes by the Indians (Birch)

Note: Place tags on objects for younger or less experienced campers

2) Follow-through

a) Share the finds
b) Create a story that incorporates the find
c) Alter the Hunt Cards
d) Go in teams...have each team make up hunt cards for the others.
...then switch
e) Try the Out-of-place Hunt

Taken from: OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES, (OBIS), University of California,

Nature's Alphabet

FIND AN OBJECT THAT BEGINS WITH THE FOLLOWING LETTERS...

A _____

B _____

C _____

D _____

E _____

F _____

G _____

H _____

I _____

J _____

K _____

L _____

M _____

N _____

O _____

P _____

Q _____

R _____

S _____

T _____

U _____

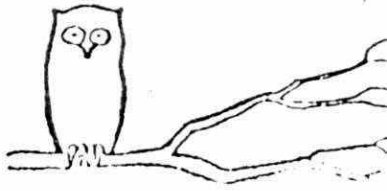
V _____

W _____

X _____

Y _____

Z _____



ABC SCAVENGER HUNT NAME:

	TREE	BIRD	ANIMAL	FLOWER
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
U				
V				
W				
X				
Y				
Z				

Activities: Seed-go (Bingo) (all ages)

Equipment

cards
seed-types

Explanation

This activity is carried out the same way as Bingo. Children find seeds that are transported by the mechanisms described. First row across, wins.

SEED-GO

SEED DISPERSAL

Look carefully at the plants in your surroundings. Decide how each plant disperses seeds and glue or tape a sample of its seed in the proper box. Some seeds may be dispersed in more than one way. The first person with five seeds in a row, in any direction, wins (same as Bingo).

Outdoor Biology Instructional Strategies

	grass	trees	bushes	weeds	garden plants
wind					
water					
mechanical					
animals					
man					

REMEMBER:
In order to win, you may have to convince others that you are correct.

Reprinted from: OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES, (OBIS),
University of California,
Berkeley, California.

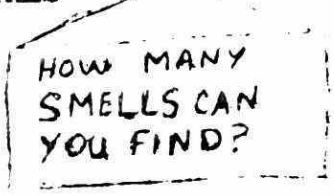
ENVIROLOPES (for all ages)

Many people enjoy a walk in the woods, along the shore, or in other outdoor places. An awareness of the variety found in nature can enhance the aesthetic appreciation and value of such walks. The colour of fall leaves, the fragrance, shape, and colour of spring flowers, the textures and patterns of trees, ferns, and mosses are only a few examples of the variety found in the out-of-doors.

Envirolopes works well in almost any outdoor setting and in a variety of different ways: along a trail, around a science center, at a camp, or on a family outing. Teams of two or three receive a challenge such as: "Find at least five different shades of green." The participants collect samples small enough to fit in envelopes, and then display and discuss their discoveries.

This activity encourages the participants to develop the ability of making observations and sharing them wtih others. In addition, the activity emphasizes the variety of colours, forms, textures, and organizms present at any outdoor site. Envirolopes works well with mixed-age groups of participants.

MATERIALS

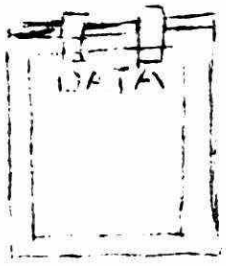


For the group:
1 copy of "Envirolope Challenges" card
1 data board

For each team of two:
1 letter-sized envelope with one challenge on it. Possible challenges include:

- O Find the ten most unusual-shaped leaves.
- O Find at least five different textures.
- O Find examples of at least five different odours or smells.
- O Find at least five different kinds of seeds.
- O Find at least five objects, each one of a different colour.
- O Find at least five different kinds of evidence that animals are around (such as a leaf with bites taken out of it).
- O Find at least five different kinds of evidence that people are around (trash, for example).
- O Find at least five different kinds of rocks.
- O Find at least five objects with different shades of brown.
- O Find at least five objects with different shades of green.

1 felt pen
* glue or tape (for adhering challenges to envelopes).



For seashore sites include:
- O Find at least five different kinds of shells.
- O Find at least five different colours on one shell.

PREPARATION

Site: Select a site where collecting small samples of leaves, rocks, and twigs or shells is not a problem. Obtain permission if necessary.

Envirolopes: Make a copy of the "Envirolope Challenges" card. Select the challenges that are appropriate for your site and group. Cut the challenges apart and adhere one to each of the envelopes.

Alternatives to collecting: If regulations or a fragile habitat preclude collecting, some alternative approaches you can take for identifying discoveries include:

1. Flagging: Use a different colour of cloth or yarn for each team. With this method, the group will have to walk around the site to discuss the choices.
2. Photograms: See Habitat Sun Prints (Set I). Compare and discuss the prints.
3. Crayon Rubbings: See Gaming in the Outdoors (Set II). Compare and discuss the rubbings.
4. Photography: Compare and discuss the evidence later.

ACTION

1. Select a discussion area and point out the boundaries of the site to the group. Show your participants an example of an envirolope challenge and encourage them to discuss how the challenge might be met.
2. Divide the group into teams of two. Explain that each team will receive an envelope with a challenge on it. The teams will have twenty minutes to search for small samples. Make a rule that each team's samples must fit in the envelope.
3. Save one envirolope for yourself, and distribute the others to the group. Circulate among the teams as they search, encouraging them to investigate further. Listen to any unusual reports and offer encouragement or assistance when necessary.
4. Call everyone back together after twenty minutes, and ask each of the teams to display their collections. Ask the teams to circulate, observing and informally discussing each other's evidence.
5. Select one or more collections that appear particularly interesting, and ask the teams to report to the group on what they collected and what their collections show. Ask the other teams to check their collections for items that could be added to the collection being shared. Continue this process for as long as the participants find it interesting.

WHAT DO YOU THINK?

1. What objects appeared in more than one collection?
2. How does the evidence of other animals compare with the evidence of people? Did you find more evidence of animals or of people? What types of evidence do animals leave? What types of evidence do people leave?
3. Which collections contained the most items? Why?
4. Which was the most difficult challenge to meet?
5. Which item, because of its variety of properties, could be included in the largest number of individual team collections?

Keep discussions short. If, however, a discussion appears to wander from biology to art or some other form of creative expression, don't feel that you have to guide the discussion back "on course." Such interest is the key to developing environmental awareness, appreciation, and understanding.

FOLLOW UP

1. Repeat the activity at a different site or at a different time of year.
2. Ask interested individuals to make up new challenges for another hunt.
3. Make a collage with the samples collected.

WHAT TO DO NEXT

Pigment Puzzles	Set III
Variation Game	Set III
Who Goes There?	Set I
Plant Patterns	Set II
Sensory Hi-Lo Hunt	Set II

Activity: Out-of-Place Hunt (all ages)

Equipment

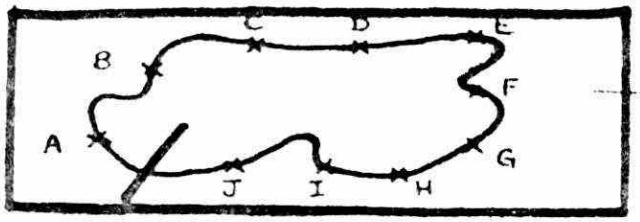
score cards (index cards)
pencil

Explanation

This hunt is a version of a scavenger hunt. It focuses on natural objects found in an outdoor site. The child must look for items that do not belong in the particular environment and record them in his/her hunt card.

Instructions:

Set up a trail before meeting with the youngsters. Mark a circular path through a previous activiy area, placing stakes or flagging with lettered index cards at intervals of three to four meters. Along the path, place natural objects in areas where they do not belong.
eg: place an apple in a berry bush
berries in an oak seedling
an oak leaf in an elm tree
a damp area on dry ground in bright sunlight.
Prepare the score cards by outlining the trail on index cards and indicating the location of lettered intervals.



score card

Then tell the children you have made some changes in the area. If they know the area well they will be able to detect the objects that are out-of-place. Give them one example.

Each child takes a score card and pencil to record the out-of-place items at each of the lettered intervals. All discoveries should be kept secret until the end of the hunt.

When everyone has completed the hunt, ask for the number of out-of-place items discovered, and compare score cards. As a group, walk the circular path again and have the hunters point out the items they found. Point out any items the children missed.

Follow-up:

In any natural outdoor setting, there are curious, unexpected things to find. Some examples are a mound of soil, one defoliated bush or tracks. A good hunter can use these curiosities as clues to the interactions that have occurred in the area, whether they be gophers digging burrows or insects eating leaves on a bush. Have the group hunt for these natural things in their activity area. What do these curious clues tell you?

Taken from: OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES, (OBIS), University of California, Berkeley, California.

Activity: Sounds (all ages)

Explanation

Have the children sit quietly with their eyes closed in an area by themselves. Everyone holds up two fists. Each time a natural sound is heard, a finger is lifted. At the end of the activity everyone compares sounds. Variations may include: birds, animals, weather, man-made or a combination of two of these. (2 hands)

Activity: Colours (all ages)

Explanation

Children (as well as adults) can discover a variety of colour in the natural world. Ask the participants to sit quietly and observe as many colours or shades of colours around them. The results may be astonishing.

Activity: Blindfold Walk (all ages)

Equipment:

blindfolds

Explanation

One child may lead another in using senses other than sight in nature, i.e. smell, touch, sound. Specific suggestions are best, e.g. for trees, "Rub your cheek on the bark. Is this tree alive? Can you put your arms around it? Is it older than you? Can you find plants growing on it? Animal? Lichen? Insects?" Re-locate the individual and have them find "their tree".

All the children in a line may follow a predetermined roped course. (Note: this requires close supervision.) This can show numerous items in the outdoors. Examples: moss-covered logs, cool forests, warm clearings, the "crunch" of dead leaves, smooth rocks, smell or soil or decaying matter. Your imagination can run wild with this one!

Duplication (all ages)

THIS is a good game for getting children interested in rocks, plants, and animals. Before assembling the children to play, secretly gather from the immediate area about 10 common natural objects, such as rocks, seeds, conifer cones, plant parts, and some signs of animal activity. Lay the objects out on a handkerchief and cover them with another handkerchief. Call the children close around you and tell them, *"Under this cloth are 10 natural objects that you'll be able to find nearby. I will lift the handkerchief for 25 seconds so you can take a good look and try to remember everything you see."*

After looking at the objects, the children spread out and collect identical items, keeping their findings to themselves. After five minutes of searching, call them back. Dramatically pull out the objects from under the handkerchief, one at a time, telling interesting stories about each one. As each object is presented, ask the children if they found one just like it.

Children have a lively curiosity about the kinds of things you'll show them - rocks, seeds, plants, and so on. When you repeat the game several times, it has a noticeable strengthening effect on the child's concentration and memory.

From Sharing Nature with Children, Joseph Cornell

References

Science in Action Series (McGraw-Hill Ryerson, 1979)

Golden Nature Guides

Peterson Guides

Sharing Nature with Children (Joseph Cornell) 1979 Ananda Press.

Follow-Up Activities

These activities could explore many areas of the field. To become attuned to the outside world is a complete activity in itself. The most important follow-up is to continue Nature exploration. The world is forever changing and continuous exposure to the environment always teaches new lessons.

For school programs further activities could follow:

For younger children:

1) Draw pictures or participate in other art activities to reinforce the nature experience.

2) Write stories or poems: place them in the Nature book.

3) Carry out various indoor activities (already listed in the Field Activities).

4) Join a Nature Club and follow some of their programs (e.g. Young Naturalists, Federation of Ontario Naturalists).

For older children:

1) Have the students plan improvement of an area with conservation in mind. Letters to the government or industry may be suggested. Have them set a plan of action to implement.

2) Take photographs and build a nature outing book or presentation for other classes or groups.

3) Join a Nature Club (Federation of Ontario Naturalists or Nature Canada).

For All Ages:

1) Make use of the activities in Sharing Nature with Children (1979 Joseph Cornell, Ananda Press). These are extremely good activities for making people of all ages more familiar with their environment.

Ontario
Ministry of the Environment

Environmental Explorations Program

SOIL STUDY

INTRODUCTION

Soil is an extremely important life-support system. It provides homes for millions of organisms as well as providing us with food. Yet the average person's knowledge of this natural resource is rather limited.

There are several interesting and educational activities regarding soil that can be carried out around the backyard or the campsite.

In the following introductory level soil study, children will define soil types and their related properties through comparison of soil samples collected from differing sites.

OBJECTIVES

(1) To develop a better understanding of soil -- its composition, soil types and their properties.
(2) To develop an appreciation of soil's importance as a life supporting system.
(3) To provide experience in conducting field studies, employing their sense of smell, touch and sight.

CONCEPTS

(1) Soil is composed of two things, rock and humus.
(2) There are different types of soil.
(3) The different types of soil are a result of:
    (a) different rocks
    (b) different humus; i.e. conifer needles or deciduous leaves
    (c) different proportions of rock pieces.
(4) The different soil types vary in soil properties.

Activities Beforehand

The instructor should familiarize him/herself with the background information in Appendix I.

1) Introduce or review what soil is made of (for younger or older children)
2) Discuss how soil is made (for younger or older children)
3) Introduce or review the term humus (for younger or older children)
4) spelling lessons for children:

   clay, gravel, gritty, loam, mineral, organic*, sand, silt, soilgrains, erosion*, fossil, pebble

   * for older children

   Note: More words could be added to this list.

PRE-FIELD TRIP PREPARATIONS

For instructors unfamiliar with outdoor field trips, a reference guide may be suggested. Shirley Brehm's A Teacher's Handbook for Study Outside the Classroom (Merrill Pub. Co.) considers all angles of a field trip.

Choosing a Field Site

Prior to beginning the field activities, the instructor should decide on a site where the group will carry out its investigations. It will be more beneficial to the campers if the site has variety, i.e.: open field, conifer trees, deciduous trees, water body, etc. In any event, a good site will have a combination of some of the above.

Clothing and Equipment Required by the Student

(1) Comfortable walking shoes (boots if bad weather).
(2) Socks
(3) Jacket or sweater if cool weather.
(4) Rain gear if unfavourable weather.
(5) Shorts or slacks for all students depending on weather.
(6) If possible old clothes that can get dirty should be worn.
(7) Pen and clipboard.

NOTE: It is stressed that the study is held outdoors unless the weather is so unfavourable that such an endeavour would be detrimental. In this case the study will be replaced by rainy day indoor activities.

Equipment Required

materials:

(1) trowels or spoons, one per team
(2) newspapers for collecting samples, one per team
(3) 5 measuring cups
(4) 4 glass jars with lids
(5) 4 identical cans with holes punched in the bottom
(6) water

(7) clipboards, pencils: clipboards of thin plywood or heavy cardboard with a pencil attached are needed for every person.

(8) soil study sheets: one per person. See Appendix II a) & b)

(9) summary chart: one per instructor. See Appendix III

(10) rock sample collection. Available from Ministry of Natural Resources, Whitney Block, Toronto; or construct your own.

(11) 2 stones

FIELD TRIP ACTIVITIES

Younger and older children:

(1) Ask the children to look around and point out any areas that appear different.
- the children will likely point out fields, conifer forests, deciduous forests, water sites, road, garden.

(2) Ask: Do you think the soil from these sites also differs?
- send teams to sample the various sites, obtaining several scoops of soil (one site per team). Include surface debris and any organisms that may be found in this sample.

(3) Teams should examine their soil sample and complete the soil study sheet. (Appendix IIa)

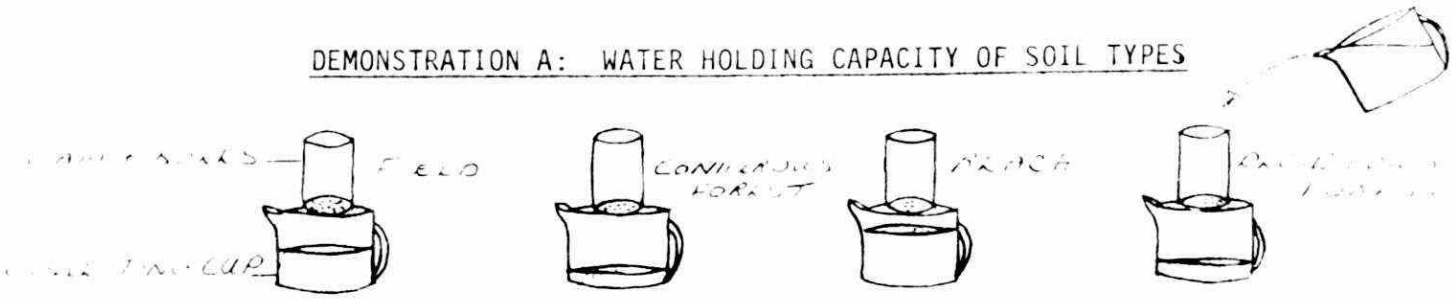
There are several ways to help children decide answers for their question sheets.

a) colours of soil can vary with the intensity of the search; have the children look quite closely.

b) Grain size may be numerically analyzed. If the value 1 is considered very coarse (e.g. gravel) and 5 is considered fine powder that could go into the pores of your skin (e.g. clay) then what would the value of the soil sample be? Help with this question can also be acquired by having the child try to rub the soil into the palms of their hands making sure big damp clumps of soil were broken down and would not be mistaken as one particle of soil.

To determine the water holding capacity of the soil samples, place a soil sample collected from each of the sites in separate cans punched with holes, to a depth of 4 cm. Pour 100 ml of water onto each soil sample. Measure the volume collected in the measuring cup, after a specific amount of time.

DEMONSTRATION A: WATER HOLDING CAPACITY OF SOIL TYPES



COMMENTS: For young children, it may be sufficient for them to realize soil collected from different sites does differ. For older children, continue on with steps #5-#10.

(4) Bring the teams together to compare the soil samples through completing the summary chart.

(5) Older children may complete the second study sheet for more details (Appendix IIb).

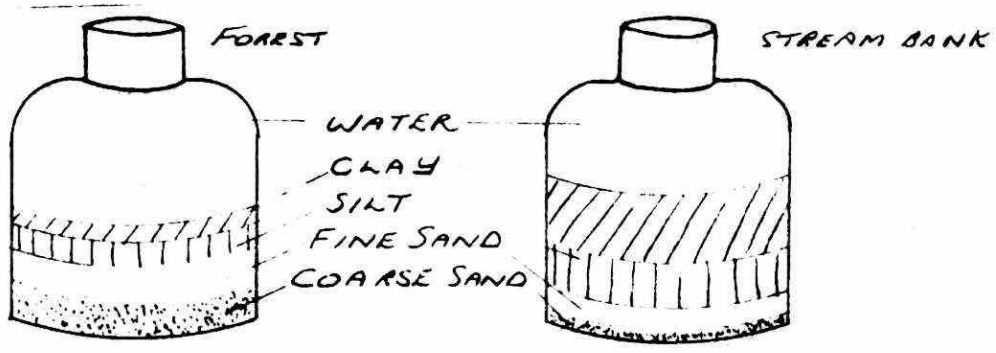
(6) Ask: Why do soils differ?
- Maybe they differ from what the soil is made of. (Minerals and parent material)

(7) Ask: What is soil made of?
(i) rocks = minerals
(ii) humus = organic material (dead plants & animals)

(8) Ask: How can rocks cause different soils?
- if different rocks form the rock portion of soils, such as limestone, shale, granite.

DEMONSTRATION B: VARIATION IN ROCK PARTICLE SIZES

Fill a glass jar 2/3 full with water for each soil sample. Pour in the soil sample until the jar is almost full. Shake vigorously. NOTE: THIS SHOULD BE DONE AS SOON AS THE SOIL SAMPLE IS BROUGHT BACK BY THE CHILDREN SO IT CAN SETTLE IN TIME. Compare the thickness of each layer between samples.



(8) Ask: What causes the rocks to break down to such tiny pieces?

(i) glaciers
(ii) streams
(iii) rain
(iv) wind
(v) erosion
(vi) roots of plants, acids secreted by roots
(vii) temperature changes - i.e. ice formation & thawing.

DEMONSTRATION C: FORMATION OF SOIL ROCK PARTICLES

Rub the 2 pieces of stone together. Comment on the large amount of work required in rubbing to form a few grains. Soil formation is a slow process, therefore it is important erosion is prevented.

(9) Ask: How does humus cause soil to differ?

- Have the children examine the litter. Different dead plant material may create different soils -- i.e.: conifer and deciduous leaves.

DEMONSTRATION D: HUMUS CONTENT

Discover the importance of humus in soil: Take two fistfuls of of soil: one from just under the sod, where it is rich in humus and well held-together by the humus; and the other from a site which is poor in humus. Place the lump of soil rich in humus (organic matter) in a "basket" constructed from 1 cm wire mesh. Then gently lower the basket into a glass jar 2/3 full with water. Repeat for the lump of humus-poor soil. Note how the soil rich

in humus will tend to hold together whereas the other soil will fall apart and drop to the bottom of the jar.

(10) Ask: What is the importance of humus? How can we measure the humus content?

FOLLOW-UP ACTIVITIES

For younger children

The Soil Game

Separate the group into two (five to eight campers in one group, the reamining campers in the second group). Assign the title "clay particle" to about one-third of the individuals of the larger group. Assign the title "silt particle" to some individuals and "sand particle" to those remaining. The second group will become a "plant part", except for one or two children who will be the animals who live in the soil.

Place the "sand, silt and clay particles" in a disorganized clump -- individuals stand at arm's length. Explain that the soil is mixed in this way: that space between the particles is filled with air, water, plant roots, organic material (decomposing), and animals. Will the soil be different if most of the particles are clay? Or sand? Or silt? A soil that contains about equal parts of each is called a "loam" soil; one containing mostly clay is termed a fine-textured or clay soil, etc. All campers hold their positions.

After this is understood, create a plant root by arranging the individuals of the small group (five or six) in a straight line, have them hold hands, and move apart until their arms are extended. The leader of this line represents the "growing point" of a plant root and he weaves his way through the spaces in the soil clump until he reaches the other side of the group. Stop and hold this position.

In order for the campers to understand that the plant root takes minerals and plant food from the soil particles, water and air from the open space, and anchors the plant growing above, ask questions such as: What does the plant need to grow? Where does it get it from? How else is the soil important to the plant? The individual animals now move about through the open spaces finding food, shelter and water. (Bacteria, molds, and other small creatures are included in the term "animals".) Following further discussion whereby campers express their experience by talking, ask them to demonstrate how the plant root and animals would move through soil which is entirely sand and soil which is entirely clay. Possible questions which could be asked include: What differences do you notice between sand and clay? Do you think plants and animals could survive very easily in soil which is entirely sand or entirely clay? Why or why not?

Repeat the above activity and ask, "What happens when rain falls on the soil?" Some runs off the soil surface, some evaporates back into the air, and the remainder passes through or is held in the soil pore spaces between the soil particles. Explain that when water runs off, it may carry soil particles away (erosion).

Repeat the game above and emphasize what happens if a building, highway, or other solid covering is placed on this soil. What may happen to the pore space? (Move closer together.) What happens to water and air? (It decreases.) What happens to the plant roots and animals living in the soil? (They may disappear.)

Repeat the soil game and emphasize what happens if grass or other vegetation is planted on bare soil. (Soil pore spaces become larger, more roots grow, and the soil will hold more water and air.)

2) In the spring, examine the organisms which live in the ground by making a wake-up garden. See instructions.

WAKE-UP GARDEN

Ever wonder how many living things are spending the winter underground. Find out by making a wake-up garden.

Equipment: After a winter thaw, dig up some soil from the top of the ground, about 0.092 m (one square foot) and 5 cm (2 in.) deep. Place the soil in a terrarium.

Terrarium: Two pieces of window glass 25 cm x 20 cm (10 in. x 8 in.) for the ends;two pieces 25 cm x 40 cm (10 in. x 15 in.) for the sides; and one piece 43 cm x 22 cm (17 in. x 9 in.) for the top. Tape the ends and sides together to make a glass rectangle. Shellac the taped cones to make them waterproof.

Spread freshly mixed plaster of paris over the bottom of a shallow pan measuring about 43 cm x 22 cm x 2 cm (17 in. x 9 in. x 1 in.) high. Set the terrarium into the pan and press it down firmly into the plaster. Allow the plaster to harden.

Put the soil into the terrarium. Place glass cover on top and set in good light. As the soil warms up, lots of little creatures that have been spending the winter underground will begin to move about. You'll also see many little plants sprouting up from seeds that have been buried in the soil.

Empty the "garden" on some large sheets of newspaper and see how many little plants and animals you can count that were living in this 0.092 m (one square foot) of soil.

Additional Activity:

Use your terrarium to raise a miniature orchard. Wash thoroughly. Cover the bottom with clean gravel or bits of broken flower pots to provide good drainage.

Spread 7 cm (3in.) layer of well-sifted sandy garden soil with some leaf mold added. Plant seeds in rows from your breakfast oranges, grapefruit, lemons, and apples. Try acorns.

From Exploring the Environment with the Handicapped,
Ministry of the Environment, Information Services.

3) Rock Collections

Mount your rock specimens in a plaster cast. Label.

Use of a rocks and minerals identification guide would be helpful. The children may want to break rocks with a hammer to look closely at the components of the rock (a magnifying glass can be used). Remember to use natural as well as man-made rock specimens.

- The proportion of the rock pieces of various sizes may cause the soils to differ.

For Older Children

(1) Take a walk to look for signs of erosion and weathering.

(2) Compare the number of animals (including bugs) in good soil with the number found in poor soil. Discuss the importance of these organisms to soil.

(3) Devise an experiment to show how soil cover prevents soil loss. Erosion can be demonstrated here. Suggestions: pour water at shoulder level into a pile of bare soil, compare it with a mound that is covered with plants or another type of soil cover, identify areas in the natural environment where erosion is present. Are there any signs of prevention?

(4) Examine the importance of decomposers in soil formation (e.g. fungi and earthworms).

(5) Obtain a soil testing kit to do chemical tests on the soil samples.
e.g. Arnold-Nasco Ltd., 58 Dawson Rd, Guelph, Ont. (cost $2.00)

Many other types could be obtained.

Simple pH tests can be done with pH paper obtained in any drug store.

An instructor may also change the pH of a soil by adding manure, lime, nitrates, phosphates and potash. Thought should be given to implications.

For all ages:

(1) Discover the importance of soil nutrients (fertilizer):
Take four (4) containers and fill them with:

(a) topsoil and fertilizer
(b) topsoil
(c) eroded soil
(d) subsoil

Plant several beans in each pot, place in a sunny location and water regularly. Note how the most fertile soil gets the healthier plant growth. Try this with different kinds of seeds too.

(2) Simple Composting of domestic waste products. Reduce the volume of garbage your camp produces and at the same time use the good soil produced in the composter to fertilize a vegetable garden!

SIMPLE COMPOSTING OF DOMESTIC WASTE PRODUCTS

Composting is one means by which we can recover tangible benefit from our garbage and in so doing, reduce the volume of solid waste requiring disposal. It can become not only a hobby, but a beneficial and economical advantage to the home gardener or camp director.

The humus material from a compost heap has long been accepted as a soil additive and mulching agent which can be produced inexpensively in one's backyard. When added to the top soil, it improves texture, porosity, and water holding capacity and increases the organic content of the soil.

HOW TO COMPOST

Generally speaking, composting involves taking organic waste material and placing it in a soil culture rich in natural organisms. The extent to which one gets involved in composting depends entirely upon the individual and the availability of the materials needed. However, this is a simple, inexpensive approach to constructing a compost heap:

LOCATION:

You can locate your compost heap in an inconspicuous corner of your yard or you can choose a central site and decorate it to suit your landscape. However, be sure that the spot is airy and sunny. If you are thinking about building a composting heap at your cottage or camp, be sure that it is away from waterways and wells and at least one foot above the water table.

CONSTRUCTION:

Home composting is best done in some form of enclosure. Choose a size convenient to your needs, whether it's a 90 cm square box or an enclosure 300 cm on a side. The pile can be as shallow as 30 cm or as deep as 150 cm.

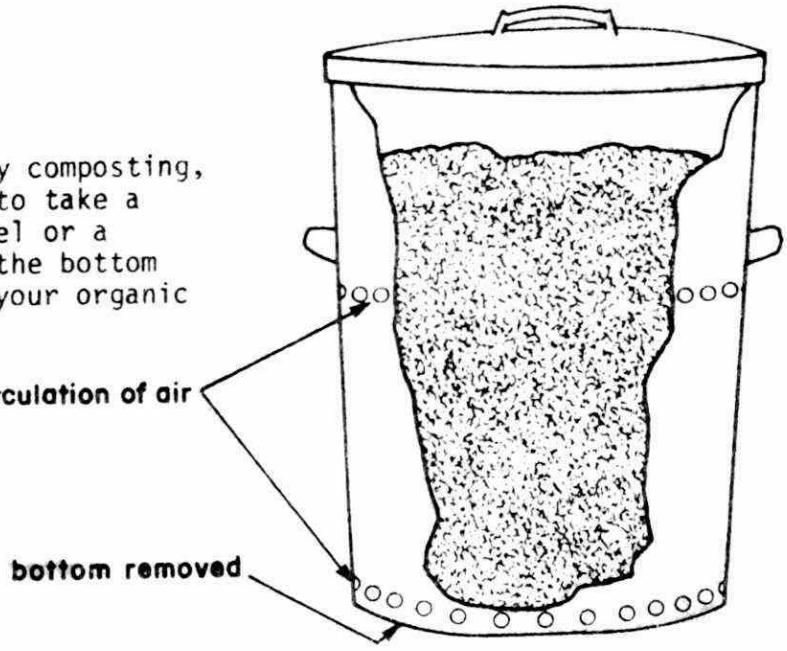
- Mark off a 120 cm square on the ground and dig a pit between 30 cm and 45 cm deep. The pit provides some warmth in winter months and keeps the compost damp in summer.

- Drive four stakes approximately 5 cm square by 60 cm long into the ground at the corners, leaving 30 cm of the stake above ground.

- From a sheet (240 cm x 120 cm) of .6 cm aspenite plywood, cut four 30 cm x 120 cm rectangles and nail them to the stakes forming a 120 x 120 x 30 cm enclosure. Leave a small space, about 2.5 cm, around the bottom so that air can circulate up through the heap. The remaining half of the sheet will be used as a cover for your heap during winter. In summer, a sheet of heavy gauge plastic placed on a 120 cm x 120 cm frame of 5 cm stock will be used as a cover. This will keep your compost heap from being a breeding ground for insects and will also help retain moisture.

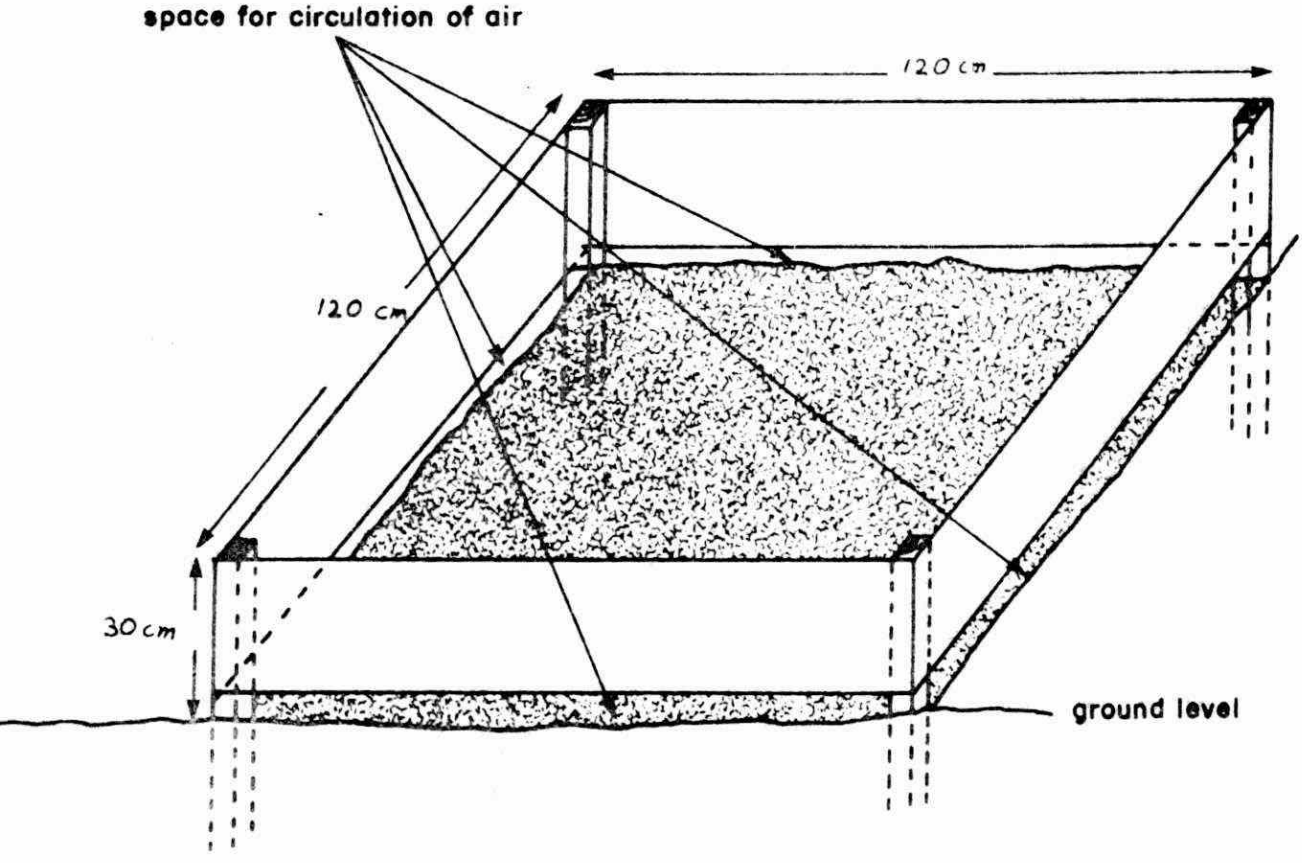
Simple enclosure:

For small-scale, easy composting, the simplest approach is to take a large garbage can, a barrel or a wooden box and knock out the bottom and set it up to receive your organic wastes.



Custom enclosure:

A composting enclosure can also be tailor-made in any size. These directions show how to build an enclosure 120 c.m. square rising 30 c.m. above ground level.



Your composting bin is now ready to receive your organic wastes.

COMPOSTING:

Many methods for adding waste material to compost heaps are used. The simplest is to add material as it becomes available. Be sure not to add thick layers of finely ground material such as sawdust. These materials will pack tight and prevent adequate circulation of air.

Another method is to arrange your compost heap into layers by placing a thin layer of a commercial starter (or fertilizer) between each 6" to 8" of garbage. The starter is used to increase the bacteria count and the fertilizer will increase the nutrient content of your pile.

Whichever method you choose, remember that for your compost heap to function adequately, it must be kept moist but not soggy. Every two or three weeks the pile should be turned. This mixes and aerates the raw compost.

While the garbage is decomposing, heat is produced. This heat should be contained by covering the pile. Heat keeps the natural organisms functioning effectively to decompose the waste.

After every turning of the heap, heat again builds up. When the heat production stops, your compost is ready to be used as low grade fertilizer and soil conditioner.

WHAT TO COMPOST:

Organic wastes are the main source of material for a composting heap. These are everyday household ingredients which can be added to a compost heap:

kitchen garbage

vegetable and fruit peelings

coffee grounds

*egg shells

*clam and oyster shells

peanut and nut shells

leaves

*sawdust

pet waste

*newspaper

barbecue grill residues

straw and hay

garden residues

grass clippings

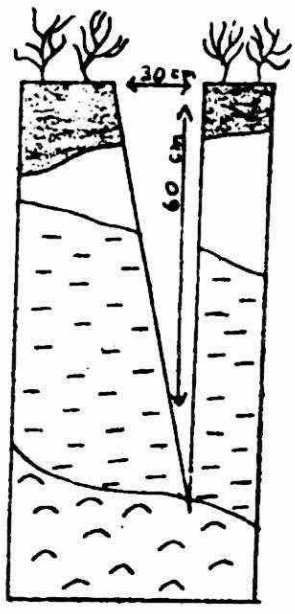
*acceptable in small quantities.

With a little time and effort, and a minimum of expense, you can successfully reclaim some of your kitchen wastes in compost and reduce, at least in part, some of your camp's garbage problems.

3) CONSTRUCTING A SOIL PROFILE

The study of a soil profile can also be undertaken by children at the primary/ intermediate level. You may find one on a hillside where road construction or erosion is occurring or you may have to dig your own.

Procedure: Use a spade to dig a hole 30 to 60 cm deep, depending on the thickness of the upper layers. Try to make one side of the hole as straight as possible.



A Typical Soil Profile

A Top soil layer, dark brown in color (several centimeters)

A2 Zone of leaching, light brown in color

B Zone of accumulation, reddish-brown in color (several centimeters - several meters)

C Parent material, grey brown in color

Allow the children to look at the hole you have made and ask questions such as: Does the color of the soil change the deeper you dig? Does it feel the same as you dig deeper? Does it look the same as you dig deeper? How far down do the roots grow? Do you think that all soil profiles look the same? Why?

The formation of soil horizons is caused by the action of plants and animals in the rock particles. They add humus to the soil. Water, percolating down, carries the fine particles of the soil to lower levels. Since organisms and climate vary from place to place, the composition and depth of the soil horizons at different places will vary. Older children may wish to do a soil profile in an old field or a deciduous and a coniferous forest.

Following a discussion of a soil profile, ask campers to construct one of their own. This can be done by using cardboard, glue, various kinds of soil, twigs, leaves, etc.

The "Soil Game" was originally prepared by the Arizona Department of Education, and appeared in the publication "Elementary Teachers Resource Guide for Environmental Education". Additional soil profile projects may be duplicated from Soil Ecology, by W. A. Andrews, Prentice-Holl Publishers, 1972.

REFERENCE:

SOIL ECOLOGY by W.A. Andrews, Prentice-Hall Publishers, 1974.

Science in Action - Soil. Ryerson Series of Outdoor Studies for Teachers. McGraw-Hill Ryerson Pub. Co.

Exploring the Environment with the Handicapped. Ministry of the Environment, Information Services

APPENDIX I

BACKGROUND INFORMATION

Basically, six factors affect soil:

1) parent material
2) topography re: flat, rolling land, mountains
3) drainage re: swamp or valley
4) vegetation, e.g. acidic pine forest
5) climate, e.g. rainfall
6) maturity, i.e. how long soil has been there.

A process called weathering causes rocks to break down into soil particles. Weathering is the physical and chemical decomposition of materials by the elements. It includes such things as the action of rain or waves beating on rocks; rivers or streams rubbing away particles of rocks; plant roots breaking up pavement and rocks; the expansion and contraction of rocks because of temperature variations and the freezing of water in rock cracks causing cracks to get bigger.

Decaying leaves, wood, and animal matter, called humus, also make up our soil. Humus in the soil is very important as it helps the soil to hold water -- thus providing plant life with water and decreasing the amount of water that runs off the land. Soil rich in humus resists drought conditions and the problems associated with water erosion.

Although soil is made up primarily of two components -- rock and humus -- we do have different types of soil. This is because rock types may vary (for example they could be sandstone or granite) and the types of humus can change (leaves from deciduous trees form different types of humus, than do coniferous leaves). Obviously too, the proportion of rock and humus changes.

The rock portion of the soil determines the colour, grain size, and texture of the soil. The smell and colour are determined by the humus content.

Soil can be divided into three types: sand, silt and clay. The soil particles vary in size with the clay particles being the smallest -- under 0.002 mm in diameter. The silt particles range from 0.002 to 0.05 mm and the sand from 0.05 to 2.0 mm. Anything larger than this is considered to be gravel or stone. (Most soils contain a mixture of the three types.)

The amount of open space between the particles affects how easily water can move through that type of soil and how much water the soil will hold.

For example, soil which consists mainly of clay takes in water very slowly and gives the water up to the plants very slowly. This type of soil is sticky when wet.

On the other hand, sandy soils that have little clay or silt particles to fill up the pore space cannot hold much water. Crops cannot live long in this type of soil unless there are very frequent rains.

Things to think about:

In the soil, you will most likely find plant roots and small animals. The roots anchor the plants growing above the surface and provide them with food (minerals from the soil) and water. Small animals move through the open spaces in the soil to find food, shelter and water.

Do you think plants and animals could easily survive in soil which is entirely sand or entirely clay? Why or why not? (consider water supply and nutrients).

What happens when rain falls on the different types of soil? If the water does not run into the soil, or evaporates it back into the air, it may run off carrying soil particles with it. This is called erosion. How can you prevent erosion?

The formation of soil horizons is caused by the movement of the plants and animals within the soil. They also add humus to the soil. In addition, the finer particles of soil are carried down to lower levels by water.

Soil is classified in many respects for its use. The most important qualities are moisture content, water-holding capacity, percolator rate, capilliarity, pore space, organic content (humus), pH (best is pH 6), temperature, the main minerals - N, P, K, Ca and the nature of the soil profile.

APPENDIX II a)

SOIL STUDY

Site:

1. Where was the soil sample taken from? _____
_____.

Soil Characteristics:

1. What is the colour of the soil? _____
_____.

2. What is the grain size? _____
_____.

3. How much of the soil is humus*? _____
_____.

4. How does the soil feel? _____
_____.

5. What does the soil smell like? _____
_____.

6. What animals did you find? Draw them on the back of this paper.

7. How much water can the soil hold?
   (a) Amount of water added _____ ml.
   (b) Amount of water that flowed through _____ ml.
   (c) Amount of water held by the soil (a-b) _____ ml.

*Humus is the black or dark brown material found in soil, formed by the decay of plants and animals.

APPENDIX II b) Classification of Soil

CHARACTERISTIC	SAND	CLAY	LOAM +
Soil sample site			
Color	light	medium	dark
Grain size	large	tiny	medium
Humus* content	slight (if any)	moderate	rich
Smell	none	foul	earthy/pine
When rolled through your fingers, it feels	rocky	dry: hard & plastic wet: stiff & sticky	gritty
Speed of water flow allowed by the sample	straight through	allows very little, if any	moderate to slow

* Humus is the black or dark substance in soils formed by the decay of animal or plant matter that provides food for plant life.

+ Loam refers to a soil that has a good proportion of sand, silt and clay.

From Exploring the Environment with the Handicapped, Ministry of the Environment, Information Services Branch.

APPENDIX III

SOIL SUMMARY CHART

SITE: / CHARACTERISTICS:				
COLOUR				
GRAIN SIZE				
TEXTURE				
SMELL				
HUMUS CONTENT				
AMOUNT OF WATER HELD				
ANIMALS				

Ontario Ministry of the Environment

Environmental Explorations Program

LITTER STUDY

INTRODUCTION

Development of an awareness of the litter problem is stressed through a variety of activities. Participants learn about garbage disposal methods and the problems facing environmentalists today.

OBJECTIVES

(1) To create an understanding about what is done with the garbage produced.
(2) To learn about the methods of garbage disposal and the problems associated with each.
(3) To foster a litter-awareness.

CONCEPTS

The children learn the meaning of:
(1) natural resources - renewable/nonrenewable
(2) the four R's of Recovery
    - reduce
    - reuse
    - recycle
    - reclaim
(3) a garbage-conscious society

PRE-FIELD TRIP PREPARATION

This study can be conducted in a classroom and a safe area outdoors. The schoolyard or camp play area are ideal.

ACTIVITIES BEFOREHAND

For Younger Children

(1) Ecology Magic

(2) Ecology Song

Sung to the tune of "Frere Jacques":

Save your tin cans, Save your tin cans,
Bottles too, Bottles too.
Put them in a big box, put them in a big box,
Good for you, Good for you.

Save your papers,
Mag-a-zines too.
Tie them in a bundle,
Good for you!

At the market,
Save your bag;
Use it once or twice more.
Good for you!

Sing each line twice and in rounds.

(From Ranger Rick's Nature Magazine, The National Wildlife Federation, May 1977, Volume 11, Number 5, pages 20, 21).

(3) Have the children think about what garbage is.

For Older Children

(1) Visit a sanitary landfill site.

(2) Visit the Resource Recovery Plant, Downsview (Toronto). Contact the plant manager for tours. (416) 635-9691.

(3) Have the participant write down each item disposed of in their home for one day.

ECOLOGY MAGIC

Name_____

If wishes could come true, here are 3 wishes I would make to help save our environment:

Wish 1_____

_____

_____

Wish 2_____

_____

_____

Wish 3_____

_____

_____

This is what my street would look like if I could make it the most natural and beautiful in the world:

DEMONSTRATION A: OPTIONAL SKIT (for younger children)

Equipment

plastic cup
empty gas can
newspaper
cigarette butt
any costumes so desired

Explanation

To introduce the garbage idea, a short skit could be performed to reveal the setting involved. This would require a brief meeting with the class beforehand in order to select and prepare a few children.

A suggestion follows: Obtain one person from the group for each of the things below:

rabbit
flower
worm
bird
fish

At the beginning of the skit, all the items live together harmoniously. As soon as this is established, send a litterbug or a "garbage unconscious" individual through. They can carelessly deposit:

1) a plastic cup (cut)
2) empty gas can in the water
3) newspaper
4) a cigarette butt.

These invariably cause the following: The rabbit cuts its foot on the plastic cup; the fish dies from water pollution; the flower smothers under the newspaper and a forest fire due to the cigarette drives away all organisms.

The purpose of such a presentation would be for the children to realize that effects of litter are not only a question of aesthetics.

Film: The Litterbug
This can be shown in the event that the skit is not performed.

(1) What is garbage?

Garbage is made up of things which people do not want any more, e.g. pop cans, old tires, food wrappers.

Discuss renewable, nonrenewable resources.
i.e. renewable - with good management, there will always be a supply of these natural resources (e.g. fish, wildlife, trees)
nonrenewable - natural resources which are limited in supply (e.g. oil, minerals)

(2) What do we do with our garbage?

Garbage is taken to a dump or a sanitary landfill site.

Dump - Garbage is heaped in piles and eventually burned. This is unsightly and is not healthy. As a result, piling garbage in dumps is being phased out of Ontario.

Sanitary Landfill site - garbage is dumped and then covered with a few inches of soil every night. When the site is completely filled, it can be landscaped and used for recreational purposes.

Make a chart to show the problems:

What happens to Garbage	Effects	Land	Resources
A) Dump	smell, rats, water pollution	waste	waste
B) Burn	smell air pollution	waste	waste
C) Landfill site	less smell recreation can't build houses water pollution	waste	waste

(3) What are the problems with landfill sites?

i) Land is wasted - can be used for recreational purposes only
ii) Difficult to find sites
iii) There is a loss of resources,
e.g. aluminum foil wrappers - when thrown away all the aluminum is lost.

DEMONSTRATION B: DEMONSTRATION OF A SANITARY LANDFILL SITE

Equipment required:

1) large empty jar with lid
2) soil
3) garbage - items such as aluminum foil, candy wrappers, saran wrap, cigarette butts, apple cores, etc.

Simulate a landfill site by alternating layers of garbage with layers of soil. The garbage should be placed at the side of the jar where it can be seen. The participants may watch the garbage decompose (to rot, break down) over a period of weeks.

GARBAGE	APPEARANCE OF GARBAGE		
	Date:_____ Week 1	Week 2	Week 3
1.			
2.			
3.			
4.			

GARBAGE	APPEARANCE OF GARBAGE		
	Week 4	Week 5	Week 6
1.			
2.			
3.			
4.			

(4) What else can be do with our garbage?

Sometimes garbage is taken to an incinerator. This creates other problems. Burning garbage pollutes the air with smoke and odours. Ashes must be disposed of later. Some of our valuable resources are still wasted, e.g. burning newspapers is a waste of valuable land.

DEMONSTRATION C: DEMONSTRATION OF AN INCINERATOR

Equipment required:

1) aluminum pie plate
2) pieces of garbage, e.g. rubber band, paper, etc.
3) matches.

One by one, items on the pie plate are burned. The participants are allowed to observe the ashes and smell the odours.

(5) What else can we do with our garbage?

The Four R's of Recovery

Reduce - Each person in Ontario produces 1.8 kg of garbage in a day.
What are some of the ways we can reduce our garbage?
- avoid disposeable items
e.g. bring a thermos to lunch instead of a pop tin.

Recycle - Some items can be recycled rather than thrown away.
e.g. bottles, newspapers, are melted down to create new ones.

Reuse - Some materials may be reused by other people once we no longer have a use for the article. e.g. toys, clothes, books, appliances etc.
- use returnable bottles (can be washed out)
- encourage garage sales

Reclaim - Some items may be used for an alternate purpose than they were originally intended for.
e.g. automobile tires used for swings in playgrounds, baby food jars for paint bottles.

(Continue the chart made in part 2)

What happens to garbage	Effects	Land	Resources
B) i) reduce (separate garbage, buy with less)	efficiency	no waste	save energy, money
ii) recycle (tins, glass, paper)	thrift	no waste	save energy, money
iii) reuse (pop bottles, milk bottles)	good for people	no waste	save energy, money
iv) reclaim (tires, jars)	items not wasted	no waste	save energy, money

The purpose of the Ontario Ministry of the Environment's Experimental Resource Recovery Plant is to extract materials such as plastics, cardboard, glass, and metal from garbage and to investigate markets to resell the materials.

Although all materials cannot be recovered, the amount that has to be transported to a landfill site is substantially reduced. The advantages of a recovery plant are:

1) it doesn't pollute our environment
2) it saves valuable resources
3) it saves space that would otherwise be required for garbage disposal.

Show movie, "A Matter of Common Sense".

(6) Discuss Composting. (see fact sheets)

FACTS

Ministry of the Environment
Ontario

ABOUT WASTE MANAGEMENT

SIMPLE COMPOSTING OF HOUSEHOLD WASTE

Composting is one means by which we can recover tangible benefit from our garbage and in so doing, reduce the volume of solid waste requiring disposal. It can become not only a hobby, but a beneficial and economical advantage to the home gardener.

The humus material from a compost heap has long been accepted as a soil additive and mulching agent which can be produced inexpensively in one's backyard. When added to the top soil, it improves texture, porosity and water holding capacity and increases the organic content of the soil.

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LOCATION:

You can locate your compost heap in an inconspicuous corner of your yard or you can choose a central site and decorate it to suit your landscape. However, be sure that the spot is airy and sunny. If you are thinking about building a composting heap at your cottage, be sure that it is away from waterways and wells and at least one foot above the water table.

CONSTRUCTION:

Home composting is best done in some form of enclosure. Choose a size convenient to your needs, whether it's a three-foot square box or an enclosure 10 feet on a side. The pile can be as shallow as one foot or as deep as five feet.

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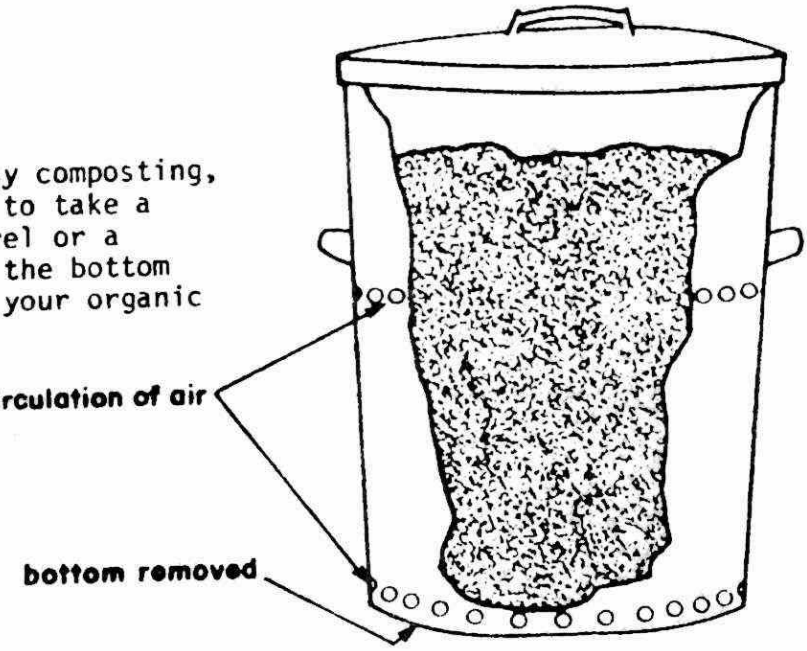
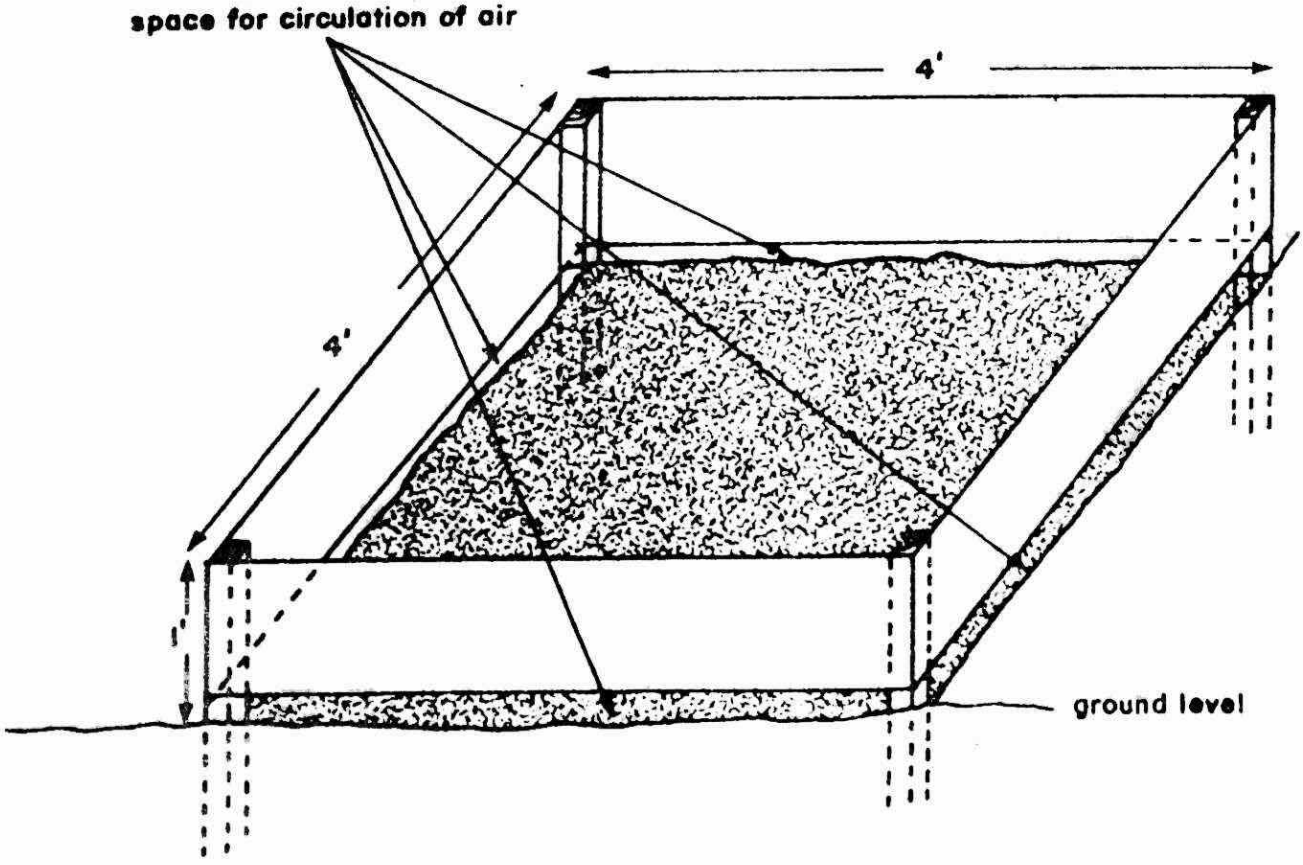


Custom enclosure:

A composting enclosure can also be tailor-made in any size. These directions show how to build an enclosure four feet square rising one foot above ground level.



- Mark off a 4-foot square on the ground and dig a pit between 12 inches and 18 inches deep. The pit provides some warmth in winter months and keeps the compost damp in summer.

- Drive four stakes approximately 2" square by 2' long into the ground at the corners leaving 1' of the stake above ground.

- From a sheet (8' x 4') of quarter-inch aspenite plywood, cut four 1' x 4' rectangles and nail them to the stakes forming a 4' x 4' x 1' enclosure. Leave a small space, about one inch, around the bottom so that air can circulate up through the heap. The remaining half of the sheet will be used as a cover for your heap during winter. In summer, a sheet of heavy gauge plastic placed on a 4' x 4' frame of 2" stock will be used as a cover. This will keep your compost heap from being a breeding ground for insects and will also help retain moisture.

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vegetable and fruit peelings	pet waste
coffee grounds	*newspaper
*egg shells	barbecue grill residues
*clam and oyster shells	straw and hay
peanut and nut shells	garden residues
leaves	grass clippings

*acceptable in small quantities.

With a little time and effort, and a minimum of expense, you can successfully reclaim some of your household wastes in compost and reduce, at least in part, some of your community's garbage problems.

For Further Information:

Information Services Branch
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

4.

FOLLOW-UP ACTIVITIES

For Younger Children

(1) Before and After.

Younger participants are taken to an area that is fairly littered. They draw a picture of the area, then clean up the garbage, and draw the same area again.

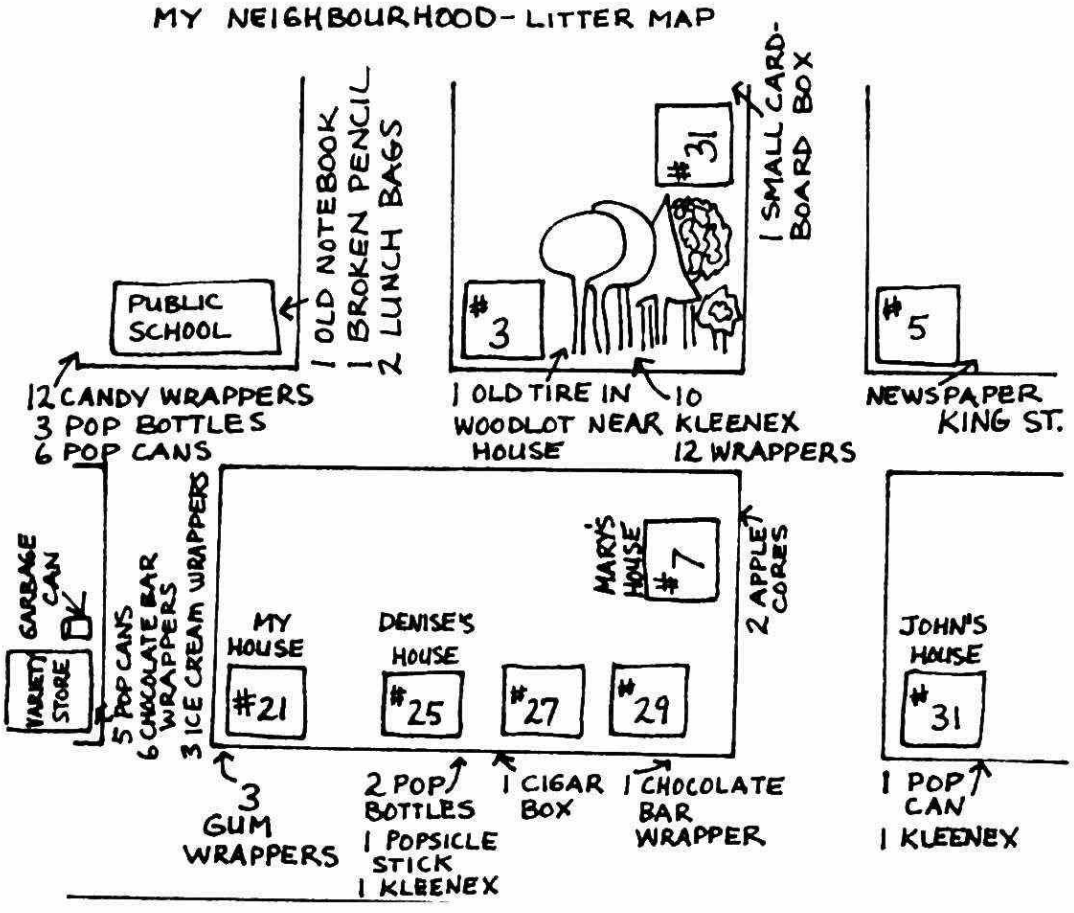
(2) Have children bring in old things they no longer want, i.e. toys. Have a sale to donate to local charity.

For Older Children

(1) After the Litter Study

Have the participants re-assess their garbage output for one day. (Done in an activity beforehand) Can the garbage be reduced? Reused? Recycled? Or reclaimed?

(2) Map an area for litter.



(3) See what can be done in your area to improve parks, etc. Write letters to Conservation Areas, government, industries, etc.

(4) Study industrial pollution.

(5) Litter competition.

Participants are divided into teams. Each team is given a garbage bag and a defined time interval to collect as much garbage as possible. The winner can be determined either by weighing the garbage, or by counting the pieces.

(6) Lost litter game.

The participants break into two groups (A and B). The area is split into two and each group is given a map. Places where litter is found are plotted on the map (Note: Litter is not collected at this time). The two groups come back and switch maps. Group A must then find all the litter marked on the map from Group B and vice versa.

Three points are scored for each piece of litter found. If Group A finds a piece of litter that was not located on the Group B map, then Group B loses one point. The team with the most points at the end of the game wins.

For All Ages

(1) Construct a Compost Heap. (See fact sheets previously)

(2) Litter Sculpture

Litter is collected and made into animals such as "The Ugly Litter Bird", "The Lousy Litterbug" etc.

(3) Make Litter Bags for your car.

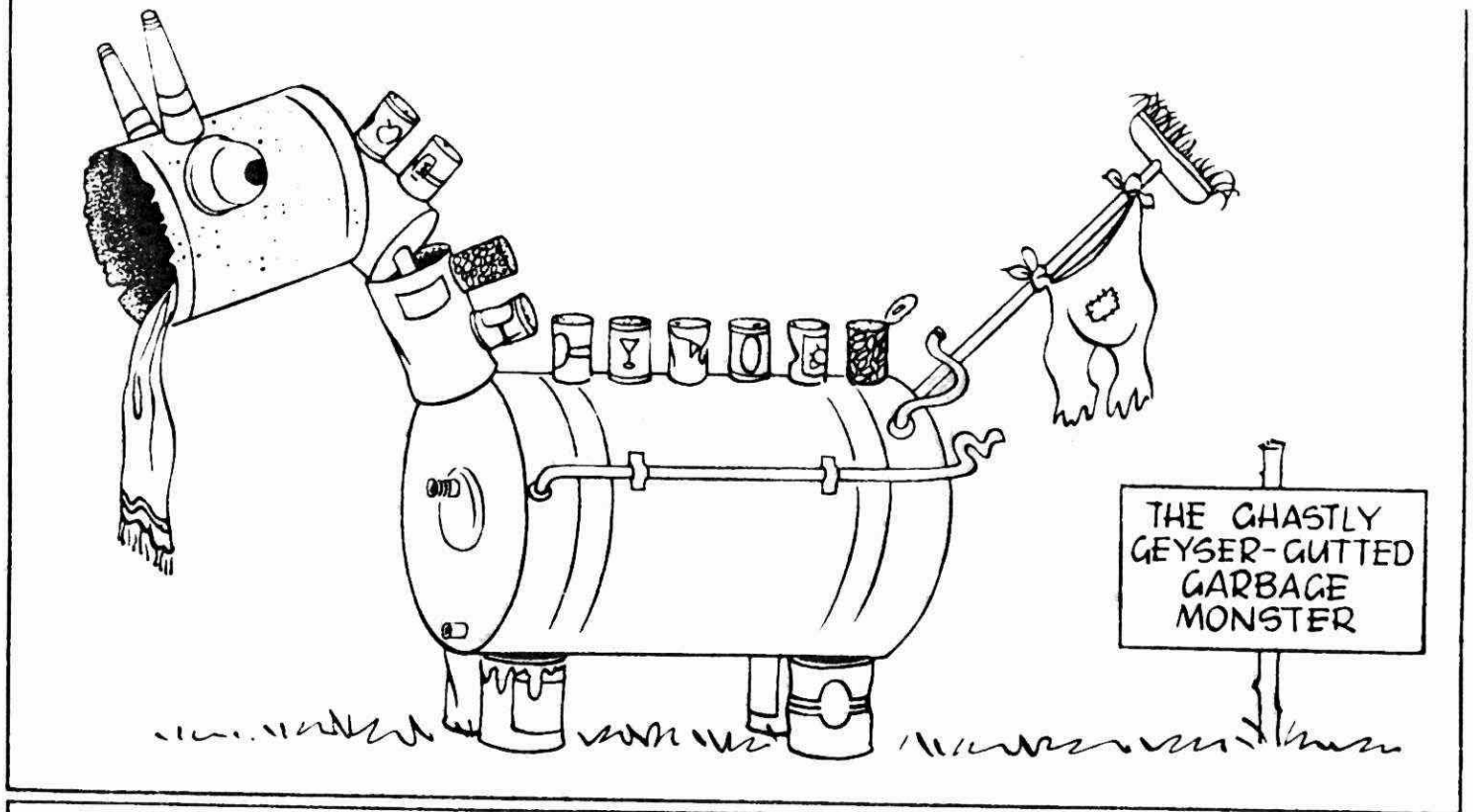
(4) Make a Newspaper Bundler.

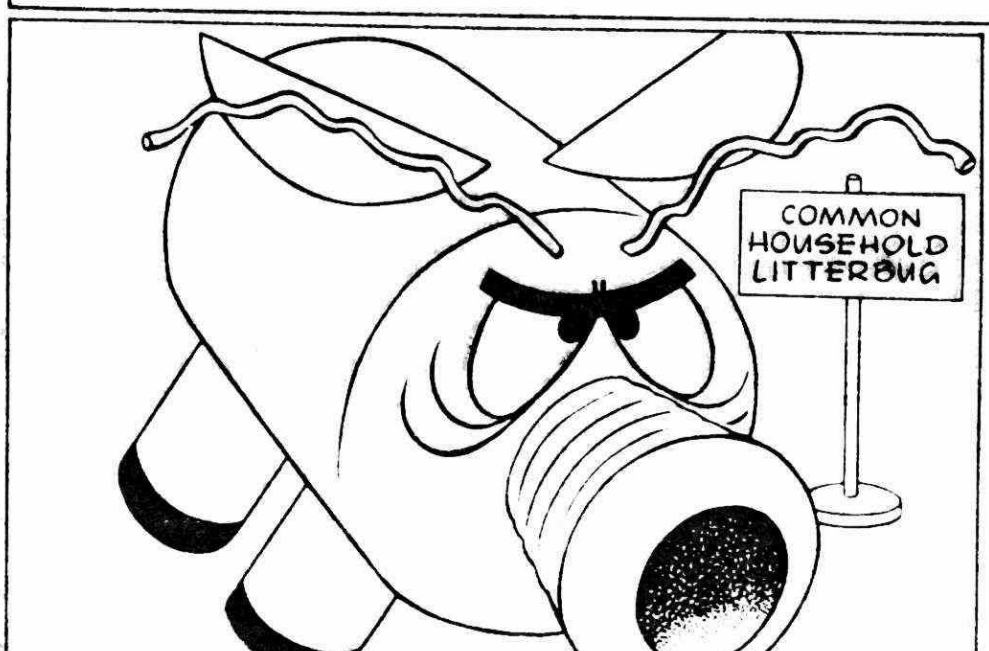
(5) Litter scavenger hunt.

Participants are broken up into pairs and sent off to find such items as bottle caps, pop tins, candy wrappers, cigarette boxes, etc.

AGE AN EXHIBITION OF "LITTER SCULPTURE"

Collect litter from a limited area showing the area on a large map. The boys work in small teams to create "sculptures" from the collected litter — along lines shown in sketch. Each "sculpture" can be given an appropriate title, lettered on a card, such as: THE UGLY LITTER-BIRD; THE LOUSY LITTERBUG; THE GARBAGE MONSTER. Depending on the design. Ideal for public display, such "sculptures" will also arouse casual interest at a public Show-and-Tell.

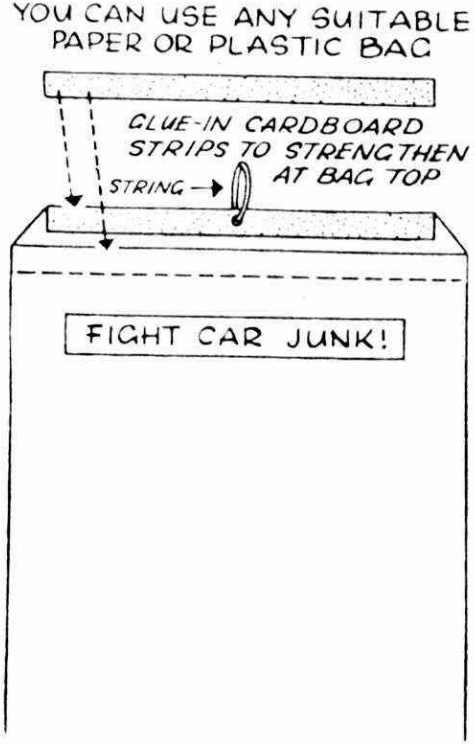


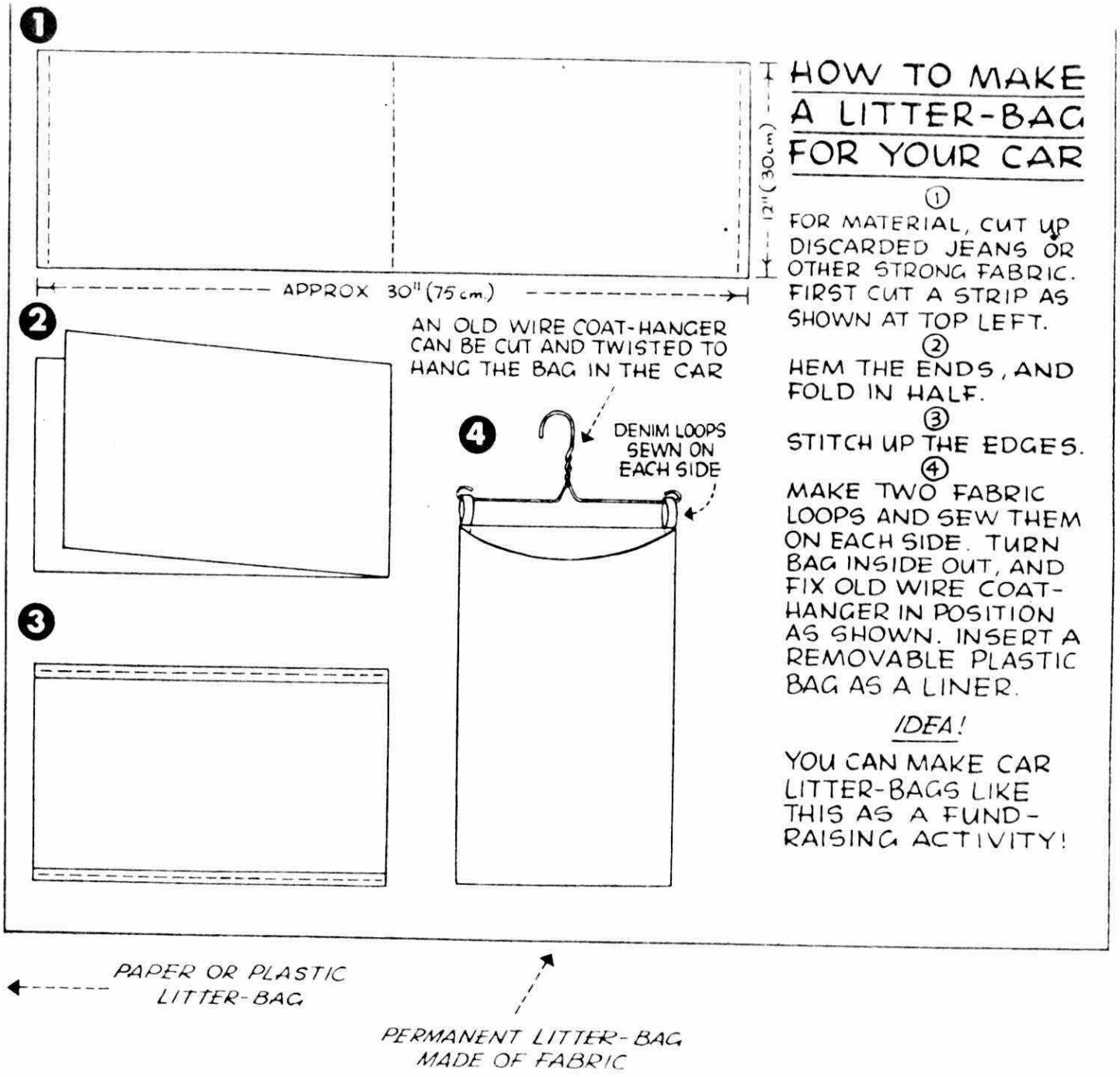


MAKE AND DISTRIBUTE LITTER BAGS

The sketches give you some ideas. Make them for the family car. Distribute some to friends and neighbours with your Scout Group's compliments. You can cut a stencil in thin card, and use a felt pen to stencil simple anti-litter slogans on the bags. Or, you can have messages carbon-typed or mimeographed — several to a large sheet of paper — and cut them up and paste them on your litter bags.

Use slogans such as FIGHT CAR JUNK . . . KEEP OUR CAR CLEAN. Use messages such as CAR LITTER THROWN ON THE HIGHWAY CAUSES ACCIDENTS, AND DISFIGURES THE COUNTRYSIDE! You can also display litter bags as a Show-and-Do exhibit, to encourage public use.

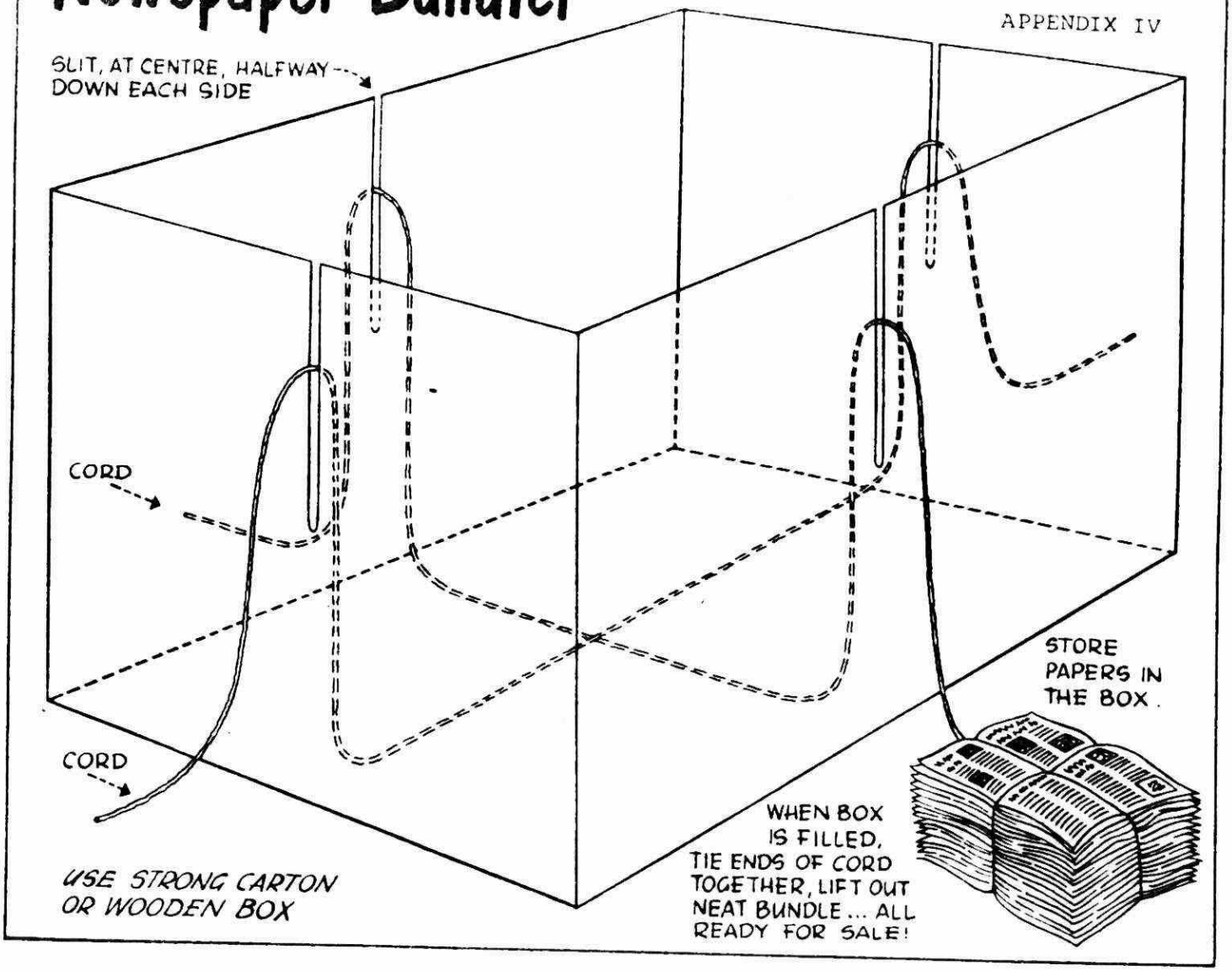




MUSCLE-SAVING NEWSPAPER BUNDLER

Like the Can Crusher, this idea comes from Boy Scouts of America. Use a wooden box or cardboard carton — see sketch. Cut a slit about halfway down from the top on the centre of the two sides and ends. Lay two lengths of cord or baling wire as shown in the illustration. Store papers in the box. When it is filled tightly, tie the cord or wire ends together ... and lift out a neatly bundled stack of newspapers, all ready for transport and sale.

Newspaper Bundler



The 3 R's

RECOVER
RECYCLE
RE-USE

From International Show-and-do Conservation Project Kit, World Scout Bureau.

INSECT STUDY

INTRODUCTION

The close examination of insects is becoming more and more popular with children today and it is no wonder, since insects with their small, delicate sizes, bright colours and fascinating habits do make interesting study projects. Every child will have had some experience with insects as they are the most numerous creatures to be found anywhere. There are over 900,000 species but some scientists say that this may only be 10 per cent of the insects discovered.

Through a field investigation we can capture and study insects for their unique features.

OBJECTIVES

(1) To develop a better understanding and appreciation of insects by examining the diversity in the appearance of insects and relating their appearance to their habitat.

CONCEPTS

(1) An insect is defined by specific characteristics which appear during stages of development in its life cycle.
(2) Insects can be found everywhere. They are adapted to a habitat to promote their survival.

PRE-FIELD TRIP PREPARATION

For instructors unfamiliar with outdoor field trips, a reference guide may be suggested. Shirley Brehm's A Teacher's Handbook for Study Outside the Classroom (Merrill Pub. Co.) considers all angles of a field trip.

Choosing the field site

Prior to beginning the field activities, the instructor should decide on the site where the group will carry out its investigations. Insects can be found in soil, trees, air, ground vegetation and a water body. An ideal site is one where there is a forested or bushy area, an uncut field section and a pond. A small combination of the above could also be used. Consideration for planning as to how far the field site is, and bussing (if necessary) is necessary.

Clothing and Equipment Required by the Student

1. Comfortable walking shoes (boots if bad weather).
2. Socks.
3. Jacket or sweater if cool weather.
4. Rain gear if unfavourable weather.
5. Shorts and slacks for all students depending on weather.
6. If possible, old clothes that can get dirty would be best.
7. Pen and clipboard.

NOTE: It is stressed that the study is held outdoors unless the weather is so unfavourable that such an endeavour would be detrimental. In this case, the study will be replaced by rainy day indoor activities.

Equipment

(1) Collecting nets: We found butterfly nets purchased from the toy section of department stores were ideal for collecting insects from the air and vegetation. They can also be made by bending a coat hanger into a ring about 30 cm in diameter. Make a net bag from nylon stockings, cheese cloth or netting of a 3 mm mesh, about 50 cm in depth. Sew the bag onto the ring. The ring and net bag can be attached to a long pole of up to 75 cm in length with tape. A broom handle or hockey stick is ideal.

(2) Bedsheet: an old sheet laid out under trees or shrubs will catch the insects as they are gently shaken from the vegetation.

(3) Containers: Petri dishes, magnifying boxes and jars of assorted sizes.

Insect container:

- container, a 2.28 litre (½ gallon) milk carton with the top cut off is ideal.
- mesh, wire screen
- string, roughly 1m or roughly 3 feet in length

Attach the string to the container to form a carrying handle. The screen can be held over the top with elastic bands. Glass jars may also be used but are not recommended because of the possibility of breakage.

(4) trowels, spoons: used to collect insects from soil.

(5) magnifying lenses: one for each team.

(6) clipboards, pencils: constructed from plywood or heavy cardboard with pencils attached.

(7) study sheets: one per person. See Appendix II.

(8) Insect Life Cycle Chart: one. See Appendix II.

(9) Summary Chart: one. See Appendix III.

Activities Beforehand

The instructor should read the background information about insects in Appendix I.

(1) Ask the children to note and report where insects can be found in their environment. (younger or older children)

(2) Teach or review the characteristics of an insect (for younger or older children).

(3) Have the children make imaginary insects for art, keeping in mind the basic characteristics. (for younger children)

(4) Introduce life cycles to the class. (for older children)

(5) Teach the concepts:

i) adaptation - adjusting to and accepting without changing the environment

(e.g. bees have wings for flying from flower to flower)

ii) modification - changing the environment to make it more acceptable to you (e.g. some insects have modified to become immune to the effects of various chemicals)
(for older children)

FIELD TRIP ACTIVITIES

Young or older children

(1) Ask: What is an insect?
Background material for studying an insect is required.
Using the drawing of a spider and insect, the housefly, point out the characteristics of insects.
A sketch of an insect could be used instead so that children will know what to look for next.

- 6 legs
- 3 body parts: head, thorax, abdomen
- 0, 1 or 2 pairs of wings
- exoskeleton
- 2 compound eyes
- antennae

It is important that the general life cycle of an insect is discussed at this time as well. (See appendix I)

(2) Ask: Where would you search for insects?
List their responses on the summary chart:

- on or in the soil
- on or in trees, shrubs
- in the air
- in water

Assign groups to collect insects from the "home" listed. Most children will find several insects right away. Others may require prodding from the instructor. Encourage collection of every insect moving in their area.

For older children

In-ground traps:

- cans, soft drink or soup cans with top removed may be used
- sugar, honey, jam or similar swee bait
- rotting meat or piece of fruit or similar solid bait

Sink a tin can or similar container into the ground placing either the sweet or solid bait inside. Cover the can with a rock or a piece of wood allowing some air space to protect any captured specimen from the rain. Crawling insects such as beetles will be lured into the can.

Younger children

(3) Each person should draw pictures on blank paper of each insect caught taking note as to details through the use of magnifying lenses. Observation should be slow and exact as many aspects may be missed through a quick view. Identification is not stressed as it can become a tedious procedure. The Golden Nature Guide can be used for quick identification. (See Appendix III)

Older children

(3) Each person should complete an insect study sheet using the insects their team collected. Use the magnifying glasses to observe the fine details. Again slow careful observation is encouraged.

Younger and Older children

(4) Bring the teams together and compare the insects found. Complete the summary chart (see Appendix III). Ideas may arise on ways insects are ADAPTED to live in different habitats. These include flight, locomotion, colouration, size and mouth parts. For example, the group sampling flying insects may find the wings of their insects larger and more obvious than the insects collected by a group from under rocks. The depth of discussion will vary with the age group.

Younger children

Basic concepts as to similarities and differences should be pointed out. Variety is an important aspect to consider. Adaptations can be brought into the discussion by asking simple questions. "How does the insect keep away from its enemies?" "How does the insect get its food?" Each child should be encouraged to discuss one insect that they have collected.

Older children

More intense ecological principles can be brought up. After filling the chart several different views of insects may be developed. Children will realize the complexity of life in insects which can be incorporated into several other fields.

(5) Return all insects to their natural environments.

FOLLOW-UP ACTIVITIES

Younger children:

(i) Make an insect out of popsicle sticks, styrofoam or any number of craft supplies. A story can be written about the insect -- where it grew up, what it eats, etc. How is it adapted to its environment.
(ii) A hunt to discover evidence of insect activity may disclose the eggs from the spittle bug; galls on goldenrod; cocoons in tree bark; insect homes like wasp's nests; ant hills; etc.
(iii) Look for spiders day (also could be done with any insect type, e.g. ants, grasshoppers, caterpillars, butterflies, bees, houseflies, ladybird beetles, snails, etc.) Collection is not stressed, however keeping the insects for short times can reveal many of their interesting habits. Research for proper care beforehand is important. All insects should be returned to their natural environment.
iv) Look for insect homes on galls, plants, trees on the ground etc.
v) Build a maze and put an ant in it. How long did it take to find the food? Try it several times. Did it take less time the second or third time?
vi) Follow a crawling insect along the ground. What does it eat? Where is its home? How fast did it move?
vii) Discuss the ways in which insects are good; are bad. Thought should be given to their importance in pollination; in producing food, such as honey; in being food for other animals and plants; in controlling week growth (e.g. the alligator weed beetle) and in controlling other insects (dragonflies eating mosquitoes). Insects may also be harmful by destroying crops, spreading disease and acting as nuisance pests like the mosquito or blackfly.
viii) Construct a classroom insect zoo. Instructions follow.
ix) Place food or scented materials out to see which insects will be attracted.

Older children:

(i) Can study the values and vices of the use of insecticides and pesticides. A trip may be planned to a local orchard to find out which insecticide they use, how it is applied, how frequently it is applied. Human control could be compared to using natural predators or insecticides.
(ii) Research how insects are harmful or beneficial to humans. Is it possible that human society could not exist without insects?
(iii) Insect Sighting in Winter. (identification sheets in Appendix IV).

(iv) A night insect study would reveal the nocturnal insects and how they are adapted to their habitat.

Night Insect Study

a) Light will attract insects: Using extension cords, place a light bulb outside, covered with a white sheet. After an hour, take a look at the creatures that have landed on the sheet. Try changing the color of the light bulb to red, blue or yellow. Which lights are attractive to night life? which are not?

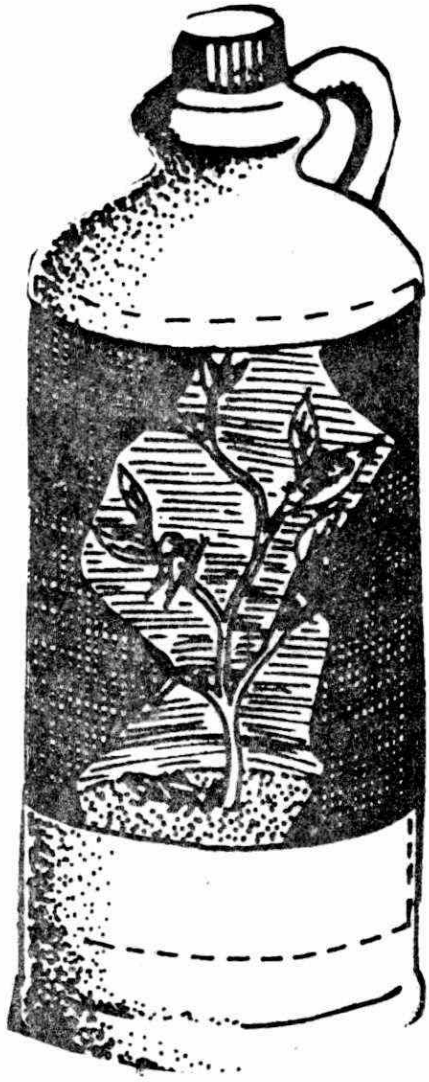
b) Some insects make their own light: Just like we "talk" using neon lights, insects also "talk". Male fireflies "talk" to the females by flashing colors. Different species of fireflies use different codes of light flashes. Using a pen flashlight, have the campers try "talking" to a firefly.

c) Smell will attract insects: Many flowers have very strong evening perfumes. Find some flowers producing a strong scent (e.g. honeysuckle, evening primrose). Ask the children to record what insects are visiting these particular flowers. A test can be conducted to determine which smells attract insects. Using cups, mix in each cup something with water that will give the water a certain smell (e.g. vinegar, honey, lemon juice, rubbing alcohol, chopped raw meat). After half an hour record which cup had the most visitors.

* adapted from ECO-NEWS, Vol. 8, No. 7, May 1978. OUT IN THE BIG DARK.

(iii) Survey several different areas for types of insects found. These can be recorded in chart form: Name Location #Found

(iv) Construct an insect zoo. Instructions follow.



Cut the top off a plastic bottle, such as a vinegar or softeners bottle. Both sections will be used.

Make a tube of window screening about 30-40 cm high and set it into the bottom half of the plastic bottle.

Arrange soil and plants or twigs in the zoo so the insects can climb and feed. Extra food may be dropped through the screw top without letting the insects escape.

REFERENCES

Insects. Golden Nature Guide Series, Golden Press, New York.

Science in Action - Insects. Ryerson Series of Outdoor Studies for Teachers, McGraw-Hill Ryerson Publishing.

APPENDIX I Background Information

An insect, like a sea animal, wears its skeleton on the outside of its body. **This is called the exoskeleton.**

The body itself is divided into three: the head, thorax and abdomen. The thorax has three segments, each with a pair of jointed legs attached; so an insect normally has six legs. Most insects have two pairs of wings attached to the thorax; some have only one pair and a few others have none at all. Insects usually have two sets of jaws and two kinds of eyes - simple and compound - and one pair of antennae.

The above is a fairly accurate description of a typical adult insect. There are however some insects whose thorax and abdomen may appear to run together. In addition, many insects in their immature forms (larvae) are worm-like. Immature insects are often difficult to identify.

Insect Relatives:

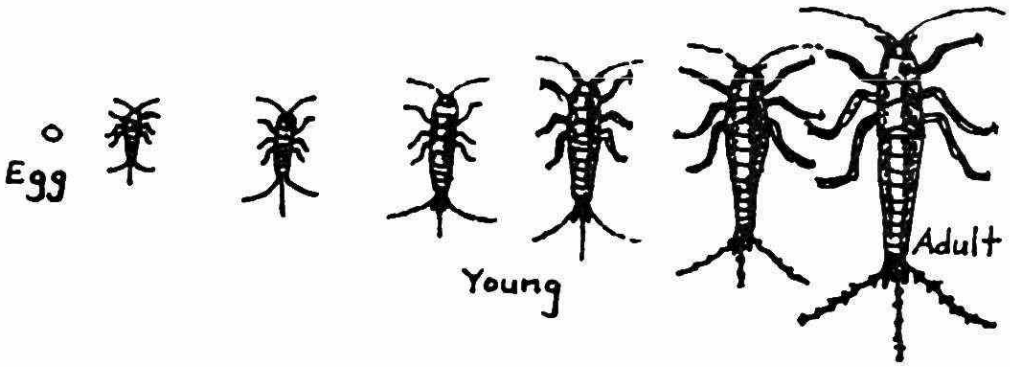
There are numerous insect-like animals which are often confused with insects - spiders, for example. However, spiders have only two body divisions, four pairs of legs and no antennae. Centipedes and millipedes are other examples of insect relatives. Centipedes have a pair of long antennae and millipedes have a short pair but both have many segments to their bodies with one pair of legs (centipedes) or two pairs (millipedes) on each.

Insect Reproduction:

Almost all insects start their lives as tiny eggs laid on leaves, tree branches, on living animals, in flowers, plant stems, fruits

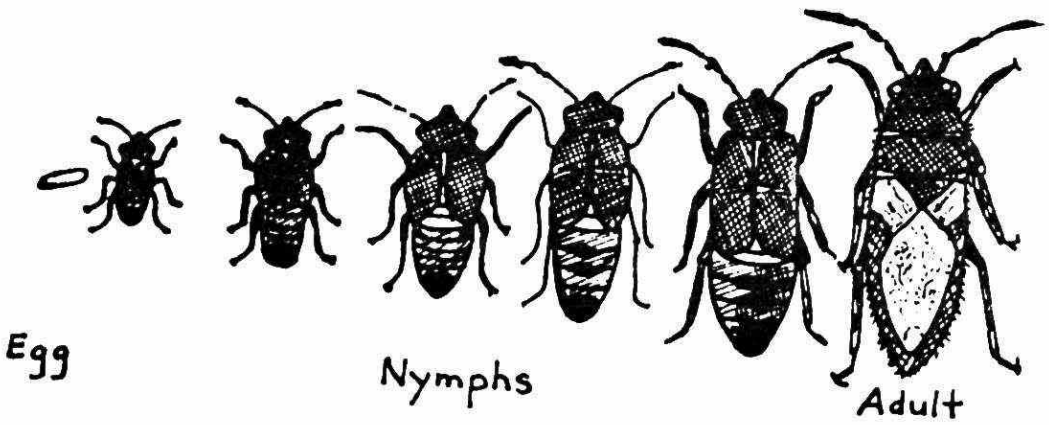
and roots, in rotting carcasses, in the ground or in water. They do, however, become adults in different ways.

In the simplest, the newly hatched insect is like a miniature adult. It grows, and molts (sheds its skin) until it reaches adult size.

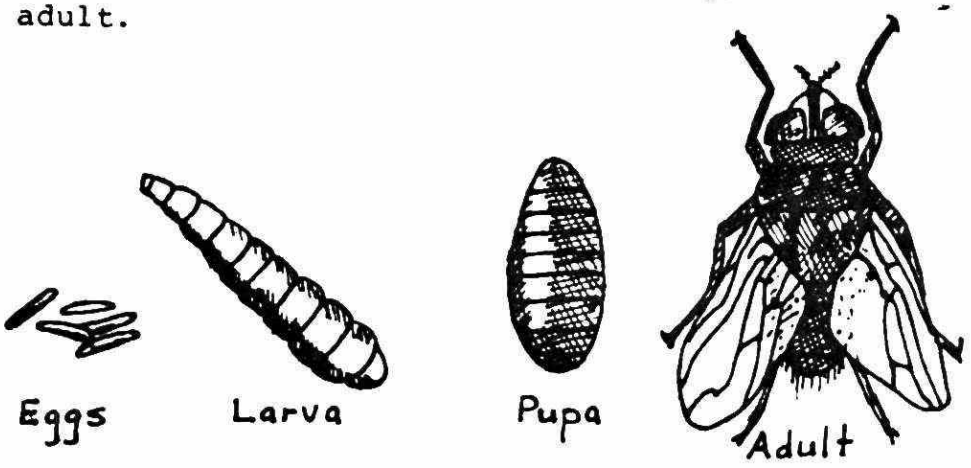


Other insects undergo a process called incomplete metamorphosis.

An immature nymph hatches from an egg, grows, develops wings and by stages becomes an adult.



A third type of reproduction is called complete metamorphosis. This involves four distinct phases: egg, larva, pupa or resting stage and adult.



Seeing, Hearing and Feeling:

An adult insect has two compound eyes - one on each side of its head. These compound eyes are made up of many tiny eyes set close together, like a honeycomb. The six-sided areas into which each compound eye is divided are known as facets. The compound eyes of ants and other insects that live on the ground have only a few facets, and their vision is not as sharp. The eyes of dragonflies and some other species may have thousands of facets.

Many species have also three simple eyes situated between the compound eyes. You will need a magnifying glass to find them.

Insects can perceive mass, motion, light, and color to a certain extent. Bees, for instance, see little of what we perceive but they can see beyond our spectrum and many plant colors are visible to them but invisible to us.

Hearing equipment is located in different parts of the body, according to the species. The grasshopper has an oval membrane sensitive to sound on the side of the first abdominal segment; crickets and ants have hearing organs in their front legs, and the male mosquito hears through its antennae.

Antennae are used to investigate surroundings and in many species are related in some degree to the sense of smell. They are attached to the head in front of or between the eyes. They vary in shape and degree of complexity according to the species.

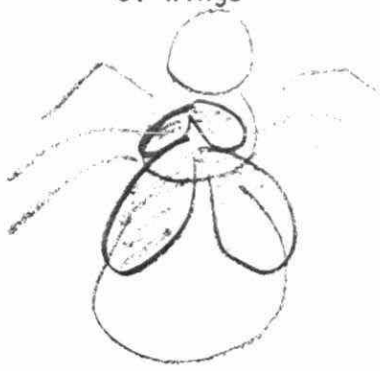
From Exploring the Environment with the Handicapped, Ministry of the Environment, Information Services Branch.

APPENDIX I

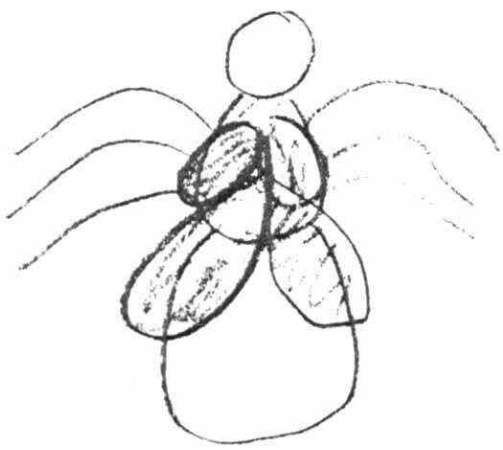
6 legs

3 body parts

0,1 or 2 pairs of wings



exoskeleton

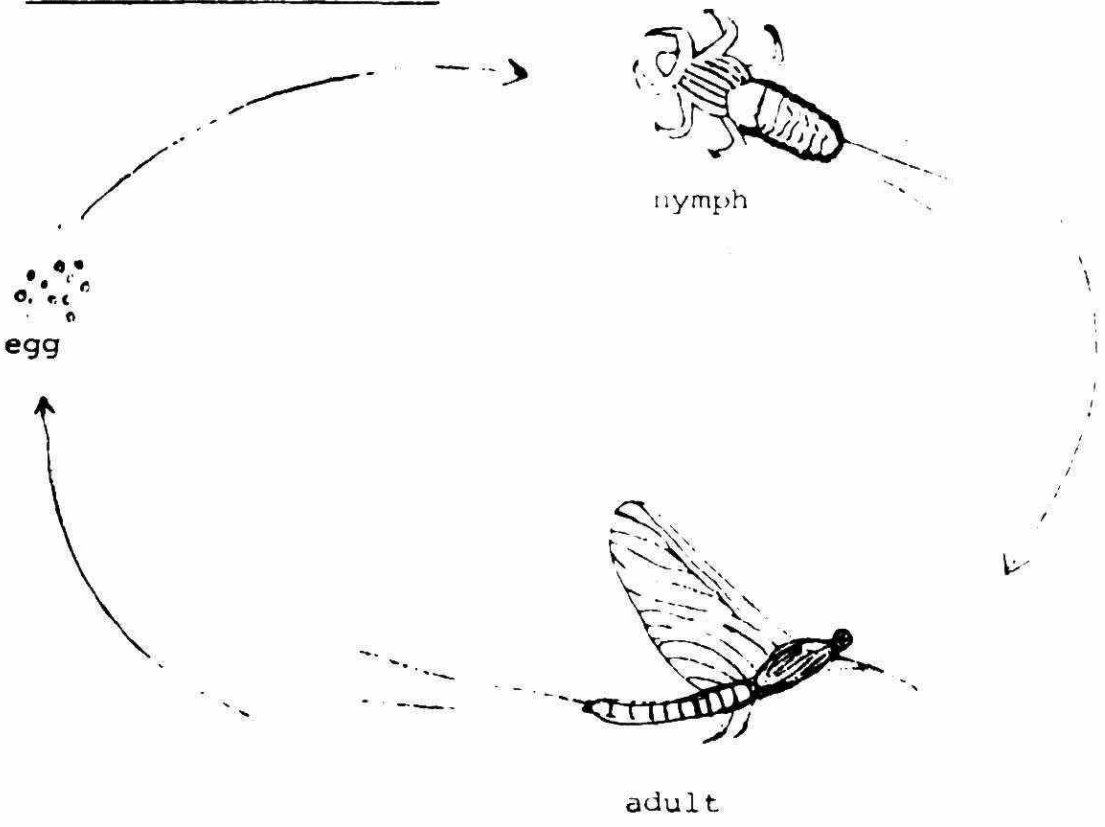


2 compound eyes

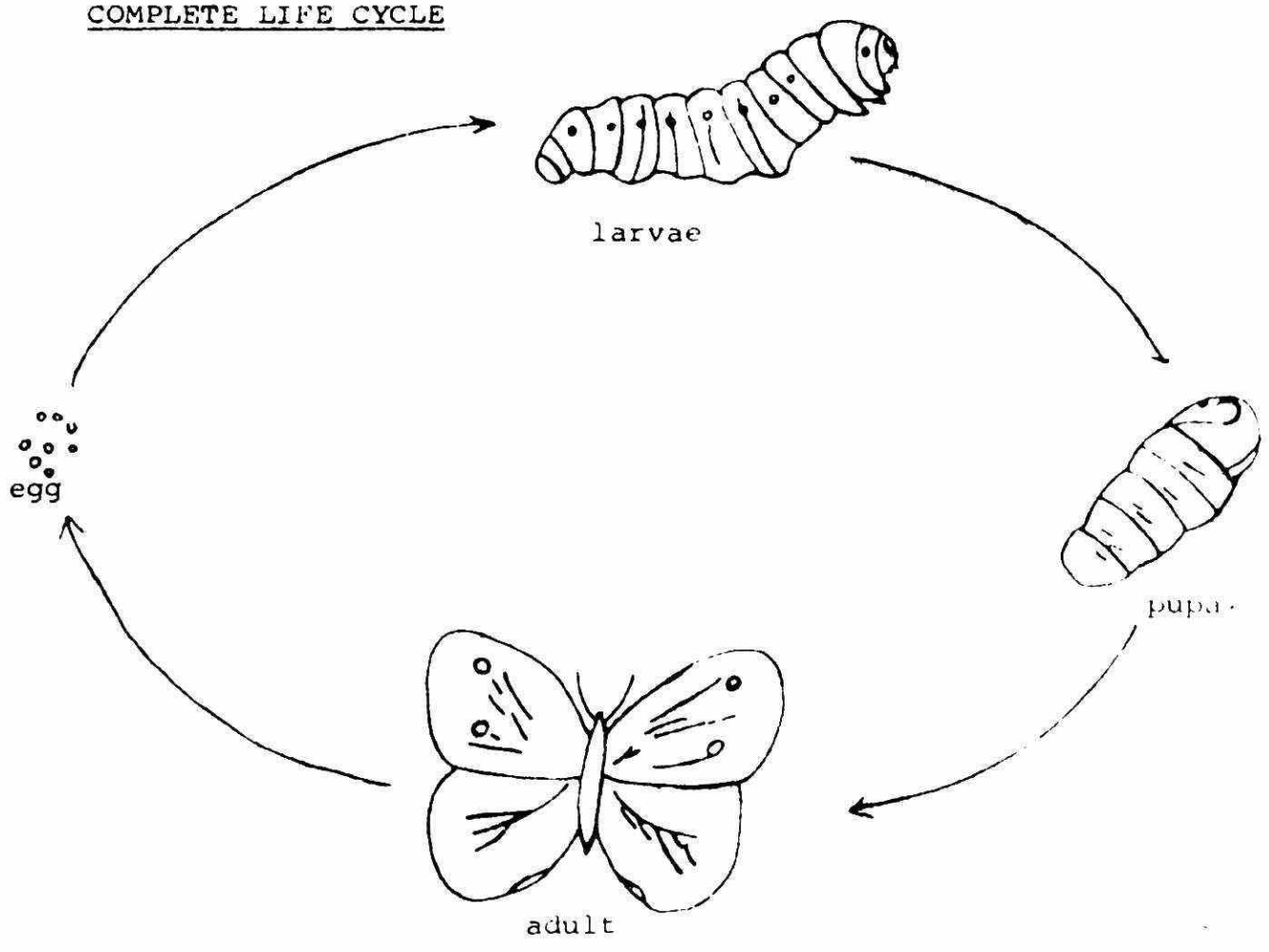
2 antennae

INSECT LIFE CYCLES

INCOMPLETE LIFE CYCLE



COMPLETE LIFE CYCLE

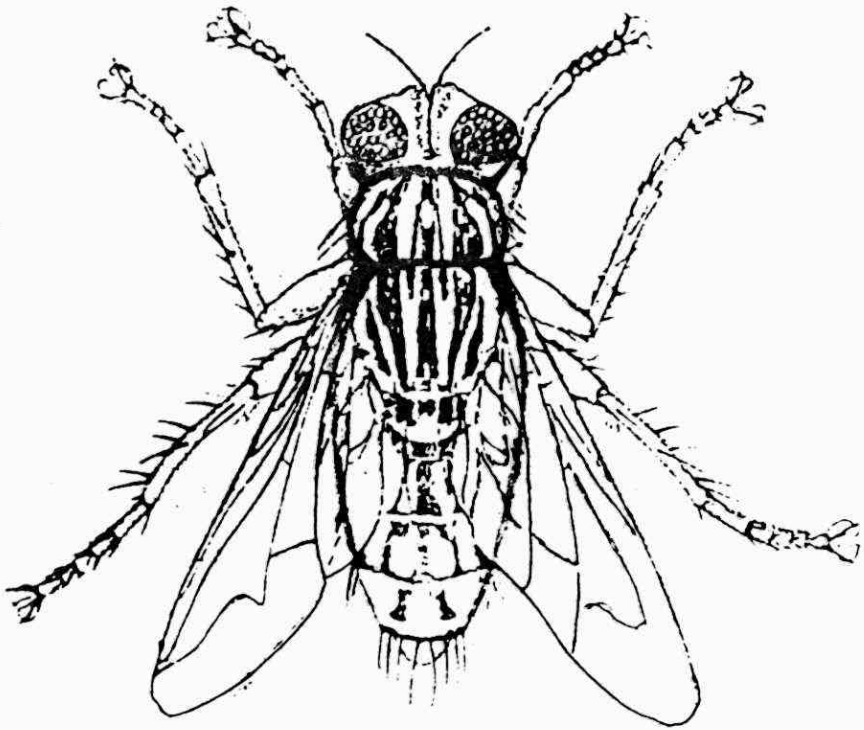


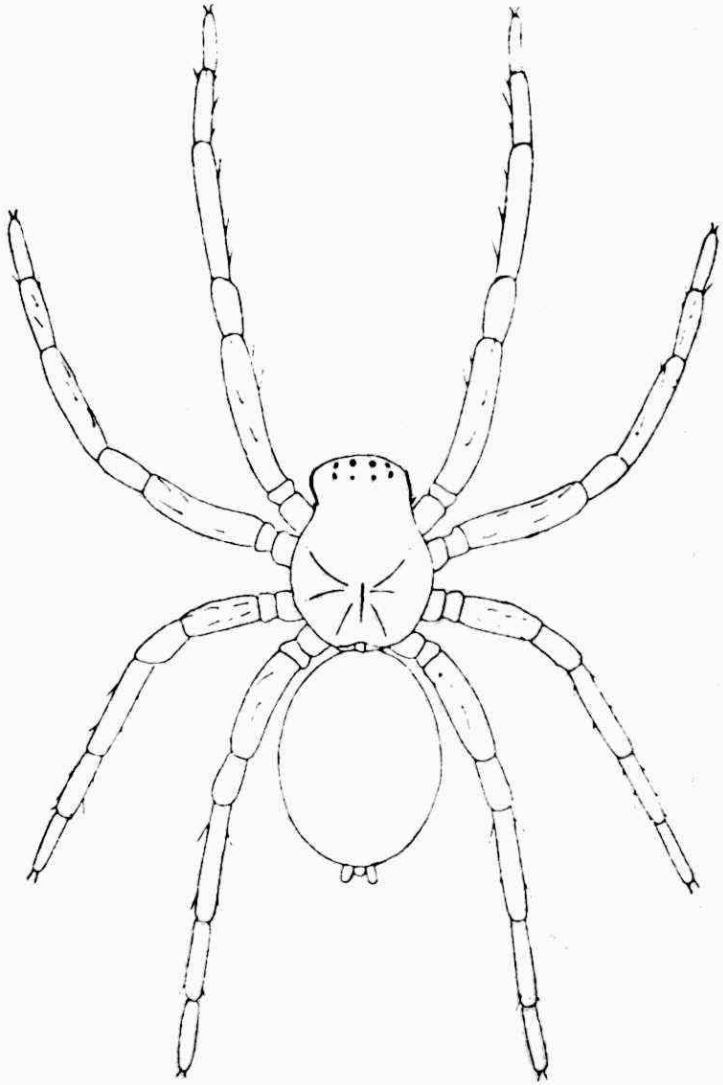
APPENDIX III

SUMMARY CHART

HOME	INSECT	SUITED TO HOME
grass	grasshopper spittlebug	- mouth parts to chew grass - blends in with grass
air	butterfly	- large wings for flying
soil	sowbug	- brown colour lets it blend in with grass

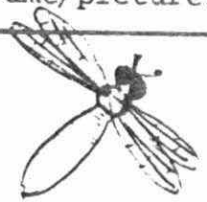
INSECT STUDY





APPENDIX I

INSECT STUDY

INSECT (name/picture)	WHERE FOUND	COLOR	SIZE	SHAPE*	TYPE OF LEGS**	DESCRIBE WINGS	TYPE OF MOUTH PARTS***	SUITED TO HOME
 (unknown)	flying in air	black and blue	4 cm	slender narrow	small	large,	sucking	- large wings for flying.
 (grasshopper)	in grass	green	2 cm	long. narrow	jumping	hidden	chewing	- blends in with grass colour - large legs for springing high in tall grass. - eats grass, mouth parts allow it to chew grass

ADJECTIVES FOR:

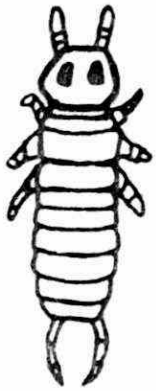
*SHAPE: round, oval, rectangular, flat, slender, square, triangular.

**LEG TYPES: running, jumping, grabbing, digging, swimming.

***MOUTH PARTS: chewing, sucking, piercing, lapping.

APPENDIX IV

Insect Sightings in Winter



Springtail (Achorutes nivicolus)

Springtails or "snow fleas" can be found at the base of a tree on warm winter days or where the sun has melted through to a patch of leaves. They are very small and at first may appear to be soot. They generally inhabit the surface of the soil, but may also live on the surface of ponds and in tidal zones. Their common name, springtail, refers to the two appendages they have on their last body segment. These are like two modified legs which are normally folded against their abdomen and held in place by two clasps. When the clasps open, these two appendages spring against the ground, propelling the insect a few inches away. This movement has resulted in their misleading nickname, snow flea.

Stonefly (order Plecoptera)

Stonefly larvae, which live in streams, start feeding and growing in fall and early winter. The adults emerge from the water in midwinter and mate on the shores; then the females lay their eggs back in the water. They are often found crawling over rocks and snow at stream edges, where as adults, they come to feed on algae. Stoneflies can live in only clean rushing water, the larvae living and feeding under stones at the river's edge. When they fly they appear like large gray mosquitoes.

Paper Wasp (Polistes fuscatus)

Male and femal wasps mate in the fall, and both go into hibernation in rock crevices and rotting logs. Only the queen lives through the winter, emerging in the spring to seek out a good nesting site. She then builds a few cells and lays an egg in each one. At this point, other queens which did not complete their own nests, join our queen and become her workers, finishing cells that she initiates and feeding the larvae when they hatch from the eggs. After the larvae are full-grown white grubs, they seal off their cells and pupate, emerging later as female workers.

At the end of summer, the queen lays more eggs which are fed extra amounts of food and develop into idle males and queens. These types hang around the nest and are fed by the workers. In the fall the males and new queens leave the nest, mate, and hibernate. Only the queens with extra reserves of fat stored in their bodies live through the winter to resume the cycle in the spring.

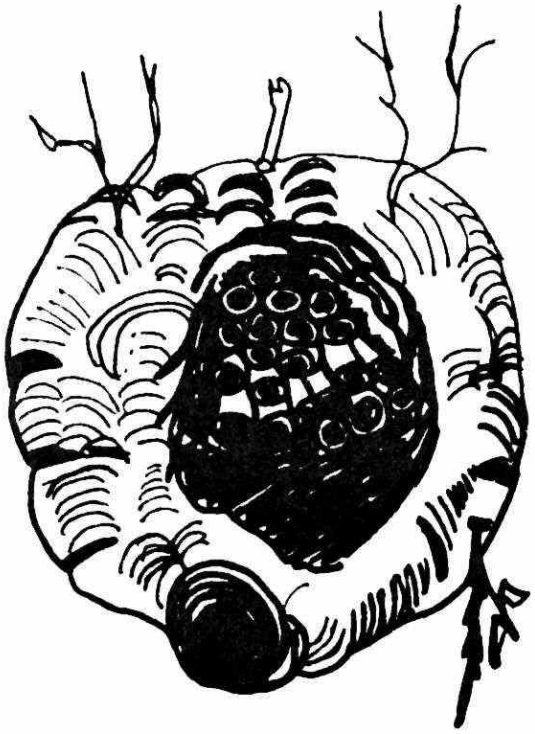
The nests themselves, are often found on the ground in the winter, blown there by the wind. Other good spots for seeing them are in abandoned sheds, garages, barns, and under the eves of wooden buildings.

They are made with dried wood and plant fibers, which are gathered from fenceposts, old buildings, and dead trees. The wasps take the wood bits to the nest, chew them, mix them with saliva, and apply them as paper pulp in circular motions to each cell. Variations in color of the cells, reflect the different sources of wood.

The nests are hung with the cell openings facing downward and are attached usually by a single thread-like *pedicel* (stalk). The top of the cells are usually coated with a shiny substance that makes the paper water-resistent.

Hornets, Yellow Jackets (Vespula species)

The life cycle of hornets and yellow jackets is the same as that of the paper wasp except that the queen is never joined by other queens.



The nests are abandoned in winter and can be safely collected and inspected after below-freezing weather has set in. They are built at any level, in trees, shrubs, or sometimes under the eves of house roofs. They vary in size from 20 to 45 cm in depth (those of Yellow Jackets often being the smaller ones).

The nests of these insects are more advanced than those of the paper wasps. After the first workers hatch, they build new cells and enlarge the nest by chewing away the inner layers of the envelope and adding new layers to the outside. Paper is made by collecting strips of dried wood, chewing them, and adding a fluid that acts like glue to hold the paper together. The paper is added on in arcs that curve away from the hive. This makes the layers quilted and holds them apart so that their insulating effect is maximized. Most nests have between six and eight layers of paper, the total covering averaging 5 cm in thickness.

If you cut open part of a nest, you will find that some of the cells may be short, which means they were never finished; some cells may contain dry larvae, which means the nest was abandoned before they matured; other cells have an added white layer of paper. These cells were going to be used a second time.

The entrance to the hive is a hole placed in one side at the base. Although the wasps abandon the nest in the winter, many other types of insects and spiders spend the winter within it.

These nests are also built underground in a mammal burrow or natural cavity. They are often found in the fall, torn open by skunks or racoons, who were seeking the grubs when the insects were slowed by the cold.

Eastern Tent Caterpillar
(Malacosoma americana)

The nests of the Eastern Tent Caterpillar are not particularly attractive in winter, when they appear as ragged masses of webbing filled with dried leaves and crumbling excrement, but they are a common sight once the leaves have gone from the trees.

In spring, when the eggs first hatch, the caterpillars crawl down the branch to the first large joining of two branches. Here they build a web for protection against such predators as birds and other insects. To feed, they leave the nest and crawl up the branches to the leaves.

The webbed nest is made communally and soon becomes filled with the remains of the caterpillar feces, as well as molted skins, for the larva, like insects in all stages of growth, must shed its skin as it grows. The caterpillars continue to add on layers of webbing, so that the final nest is made up of many layers filled with excrement and molted skins. This stage lasts six weeks. At this point, after a certain number of molts, they drop from the nest and spin cocoons in sheltered areas.

In three weeks they emerge as adult molts, then they mate and the females lay their egg masses on host twigs. These egg masses can also be found in winter. They contain 100 to 300 eggs and are surrounded with a shiny, waterproof, foamy material. An excellent place to spot egg cases is a group of Black Cherry or Chokecherry trees.

Old nest of tent caterpillar

ADAPTATIONS

For the Mentally Handicapped:

A see-item-live-creature-hunt is usually successful. Insects must be caught, sighted by a judge and released alive.

Note: care must be taken that the youngster does not accidentally kill the insect as it could be very upsetting.

Try this game!

1. Each youngster is given a picture of an insect with numbered parts.
    1. Antennae
    2. Compound Eye
    3. Head
    4. Thorax
    5. Abdomen
    6. Leg
2. Each youngster takes a turn throwing a die.
3. The youngster then colors in whatever section the number on the die indicates.
4. If he throws a number for an already colored-in section, he passes the die on to his neighbour.
5. The first person to color in the whole insect is the winner.

For the Blind:

See games and suggestions in Lawn Section.

Ministry of the Environment
Ontario

ACID RAIN STUDY

(for grades 7, 8, 9)

Introduction

Acid rain is one of the most pressing environmental issues facing the world today. By instilling an awareness of the problem in the children of today, we may be able to find solutions to the problem for tomorrow.

Objectives

1) To develop an understanding of the concepts and implications of the acid rain problem facing our province.

Concepts

1) What is an acid?
2) How is rainwater made acidic?
3) What is the effect of acid rain on aquatic and terrestrial organisms?

Pre-field Trip Preparation

The instructor should place a container outside to collect the falling rainwater. The container should not be placed in a position where there is any water contact with an overhanging roof, etc., but rather in an open area where the rain is falling freely from the sky.

Choosing the Site

This activity can be carried out in a classroom setting.

Equipment

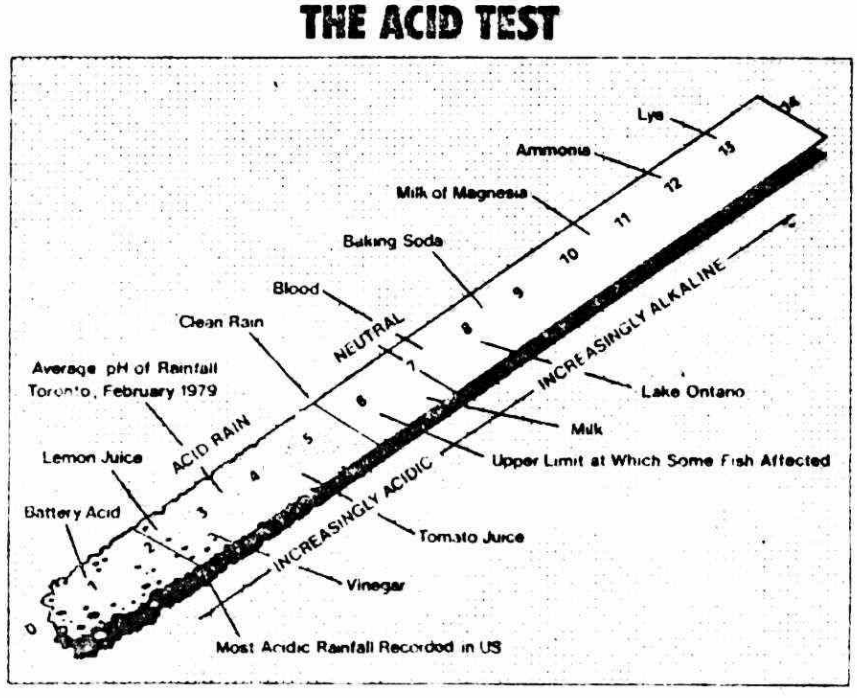
1) four containers: i) to collect rainwater, ii) containing distilled water, iii) containing vinegar, iv) containing ammonia solution
2) pH paper
3) pencils
4) study sheets: one per person
5) study charts: pH scale chart, formation and storm trajectories chart, blank chart

Activity

There is a scale for measuring the strength of an acid or base called the pH scale which runs from zero to fourteen. On the pH scale, number 7 is neutral, 0-6 is acidic and 8-14 is basic.
Ask: What is an example of an acid?
An example of an acid is vinegar or lemon juice.
The opposite of an acid is called a base.
An example of a base is baking soda or ammonia.

Demonstration

a) collect some rain in a container outside
b) set up the containers as follows: i) vinegar
ii) distilled water
iii) ammonia solution
c) test the pH of the above solutions using the pH paper
d) set up a scale and stick on the results



e) then test the pH of rainwater, and plot on the line

Ask: Is rainwater acidic or basic?
Rainwater is acidic.
Why is rainwater acidic?
Rainwater is normally slightly acidic, but becomes more acidic due to emissions from industry (burning of coal, oil, and power generating plants) and also to car emissions.

How are emissions transferred into acid rain?
There are four stages: (put stickers on chart)

1) emission — example: smoke out of a stack
2) transportation — example: wind blows smoke around
3) conversion — example: chemicals in smoke combine with air to form acids
4) fallout
   a) wet deposition example: snow, rain
   b) dry deposition example: small particles the size of dust, gases

Ask: Where are the emissions coming from?
Look at the storm trajectories chart.
Emissions are coming from:
i) Western Canada - oil fields
ii) Sudbury area - nickel refining
iii) United States

Why is acid rain a problem? (What are the effects?)

1) Aquatic Ecosystems are affected
   Before the fish die, all the other organisms such as clams, snails, crayfish, aquatic insects, and frogs die. (food chains)
   Fish die in three ways:
   a) Bones decay, muscles don't. Deformed bodies become functionless.
   b) Chemicals, which are released from the soil, clog up the gills so that the fish can not breath.
   c) Female fish fail to reproduce at certain pH's. If fish are born, they die very quickly.
   Once the aquatic organisms die, the whole food chain is affected.
2) Leaves of plants are affected

Because of the above two effects, industries such as tourism, fishing and forestry are threatened.
3) Building and automobile surfaces deteriorate. There is an erosion

of marble and metal surfaces.

4) Heavy metals such as mercury and lead, which are poisonous to humans, are picked up with the winds carrying the acid particles. Fish who are not located near any sources of pollution have been found with high levels of mercury and lead. A regular diet of fish poses a health hazard to humans.

   Heavy metals in untreated drinking supplies are also hazardous to humans.

   Emission particles fall to the earth, and some are breathed into human lungs, causing chronic bronchitis and emphysema.

Summarize problems on the blank chart.

1) Industries such as tourism, forestry, fishing are threatened.
2) Building, automobile surfaces deteriorate.
3) Health problems result.

Then, show film 'Crisis in the Rain'.

Follow-up Activities

1) Further information on acid rain may be obtained from:
   Information Services Branch, Ministry of the Environment,
   135 St. Clair Ave. W., Toronto, Ont. M4V 1P5
   a) FACT sheets
      i) Acidic Precipitation: Fish Population Study
      ii) Acid Sensitivity Survey of Lakes in Ontario
   b) The Case Against the Rain, published by the Ontario Ministry of the Environment
   c) Downwind, The Acid Rain Story, published by Environment Canada

References

This study was compiled from information supplied in Environment Canada's 'Downwind, The Acid Rain Story', and The Ontario Ministry of the Environment's 'The Case against the Rain'.

SOME THINGS TO DO

1) Does it make a difference if the rain is collected at tne beginning or at the end of a storm?
2) Does it make a difference if the rain is collected during a violent storm (thunderstorm) or from a gentle rain?
3) Does it make a difference if the rain is collected in the open (a rain gauge) or from your roof (a downspout or can below the eaves)?
4) Does it make a difference where the storm came from? (Hint: Use the day-to-day weather maps in your newspaper or watch the TV weatner news to trace the path of the storm. Did it pass over any large cities or vast expanses of farmland?)
5) Would it make a difference if you did this experiment in the winter and used snow instead of rainwater?
6) Does it make a difference if the rain is collected at night or during the day; during the week or from a week-end rain?

EXPERIMENT

The Effect of Acid Rain on Vegetation

Part A

1) Plant cut ends of Coleus, Begonia or African violet leaves in vermiculite (or soil or jar).
2) Water some with rain water and some with tap water.
3) Note the time it takes for roots to develop in each case. Which group of plants will grow faster - those in rain water or those in tap water?

Part B

1) Follow the directions for Part A above, but use five different pH's (ie. pH 2, 4, 6, 8, 10).

Variations

1) Use different plants to do the experiment.

2) Use seeds for the experiment.

EXPERIMENT

Studying pH

1) Collect a variety of common and safe solutions
   a) shampoo
   b) fruit juice
   c) baking soda
   d) vinegar
   e) tap water
   f) spring water
   g) pond/swamp water
   h) distilled water
   i) antiseptic solutions
   j) bleaches, etc.

2) 'Mask' some of the unknowns with food colouring

3) Have a set of numbered jars for each group of students

4) Keep a master list of the solutions and the pH readings

5) Have the students measure and record the pH's for each solution

Student Sheet

Jar Number	pH			Acidic or Basic?
	Trial 1	Trial 2	Average	

Summary Chart

Jar Number	Sample Solution	Trials						Average pH
		1	2	3	4	5	6	

EXPERIMENT

The Effect of Acid Rain on Cloth Fabric

Equipment

6 135mm cardboard slide mounts
Fabric (including nylon pantyhose)
Scissors
6 Microscope slides
Masking tape
Prepared stock solutions
pH paper or pH meter
Hand lens (optional)

Recipe for Preparing Stock Solutions

1) pH=1 Add 5.5 ml of conc. H_2SO_4 to 94.5 ml distilled water

2) pH=2.5 Add 10 ml of Solution 1 to 90 ml distilled water

3) ph=3.7 Add 10 ml of Solution 2 to 90 ml distilled water

4) ph=4.2 Add 50 ml of Solution 3 to 50 ml distilled water

5) ph=6.4 Add 10 ml of Solution 4 to 90 ml distilled water

6) Control Use distilled water - What is the pH?

Method

1) Cut a square piece of fabric (nylon pantyhose) which is a little larger than the slide mount opening. Cut six of these.
2) Stretch the cloth sample over the opening so that the wrinkles are removed, and then tape it to the sides of the mount.
3) Label each slide with the number that appears on each of the six solutions.
4) Set each slide mount, label side up, on top of a microscope slide. The slide will act to catch any acid that might drop through.

5) Place one drop of the appropriate acid solution on each clotn sample.
6) Observe the mounts for the next few days. Each time a drop dries up or disappears, place another in the same location.
7) Examine the cloth daily for any changes in the cloth sample. Record the changes.

pH of solution	damage noticed after		observations
	# of drops	days	

8) To test for damage:
   a) run a fingernail/screwdriver over each fabric piece (1, 5, 10 times) Make sure it is the same number of times for each)
   b) check for prescence/absence of a hole or broken threads
   c) a spring and mass could be attached to the fabric to discern whether the fabric strength has weakened. (remember to test the strenth of the control piece)

Questions

1) Which solution has the least/most effect on the cloth?
2) From this experiment, how safe are you in assuming that acid precipitation damages cloth?
3) Design an experiment for investigating the effects of acid rain on:
   a) house paint
   b) automobile finishes
   c) marble statues

Variations

The variables that can be changed in this experiment are: 1) pH of solutions, 2) kind of material (fabric) used, 3) number of drops applied, 4) temperature of solutions, 5) number of fingernail strokes across the spot, 6) colour of the material

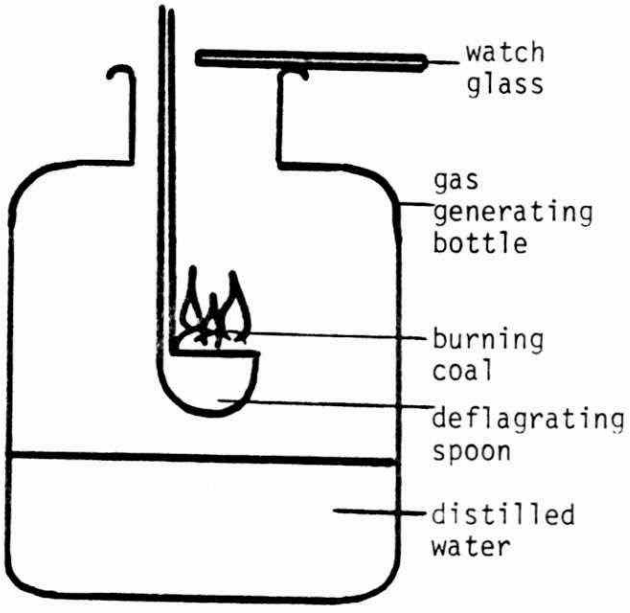
EXPERIMENT

Study of Emissions

It is well known that the combustion of coal in the production of electricity is a major contributor to acid precipitation. This study investigates the effect of coal emissions on water.

Equipment

gas generating bottle
deflagrating spoon
watch glass
phenolphthalin
0.05 N NaOH
Bunsen burner
soft coal
pH paper
distilled water
medicine droppers
beakers



Procedure

Part A

1) Add 15 ml distilled water to the gas generating bottle.
2) Determine and record the pH of the solution.
3) Fill the deflagrating spoon with a lump of soft coal.
4) Use the bunsen burner--in a fume hood--to set the coal on fire. When the coal is burning, lower it into the gas generating bottle and cover the mouth of the bottle with the flat watch glass plate.
5) Hold the spoon above the water and let the coal burn until the flame suffocates.
6) Remove the spoon and swirl the water in the bottle.
7) Determine and record the pH of the solution.
8) Keep the solution for Part B of the experiment.

Part B

1) Place 15 ml of distilled water in a beaker.
2) Add one drop of phenolphthalein solution to:
   a) distilled water in the beaker
   b) to the solution in the gas generating bottle (Part A)
3) Add drops of NaOH solution to:
   a) the distilled water
   b) to the solution in the gas generating bottle

   until they turn red.

4) Record the number of drops for each.

EXPERIMENT

Lake Sensitivity to Acid Rain

What is it that makes lakes sensitive to acid rain? Why is it that some lakes are more affected than others? Many factors can be investigated:

ie. chemical composition of soils
geological characteristics
climatic patterns
types of vegetation present

This experiment investigates the effects of acid rain in different bedrock materials. Does the composition of the lake basin material (bedrock) make any difference to a lake's sensitivity to acid rain?

Equipment

600 ml of 0.1 M H_2SO_4
pH paper
100 gm $CaCO_3$ (marble) for each student or group
100 gm crushed granite for each student or group
one (1 litre) beaker
three (400 ml) beakers
one stirring rod
one medicine dropper
one graduated cylinder

Procedure

Part A - Making the 'Acid Rain' Solution

1) Fill a 1.0 litre beaker with 900 ml of tap water.
2) Add the H_2SO_4 acid drop by drop. As you add drops, stir the solution constantly and thoroughly; then measure the pH until the pH paper gives a value of 4. When the solution reaches pH of 4, wait one minute and then remeasure the pH to be sure that it still has the same value.

Part B

1) You will need three 400 ml beakers.

a) Place 100 grams of marble in one beaker.
b) Place 100 grams of crushed granite in another beaker.
c) The third beaker contains no basin materials.

2) Add 300 ml of 'Acid Rain' solution to each of the three beakers.

3) Record the pH in each of the three beakers.

4) Make a prediction (or hypothesis) about what you think will happen to the pH in each of the beakers.

5) Let the three beakers stand over night and record the pH in each the following day. Repeat daily for one week. Record the data in the following table.

pH of 'Lake'

Day	Marble Bedrock	Granite Bedrock	No Bedrock
0			
1			
2			
3			
4			
5			
6			
7			

Questions

1) Which of the three simulated lake basins was least affected by the acid rain?
2) Which was most affected?

Variations

1) Try varying the amount of bedrock in each 'lake'. ie. 1 gm, 10 gm, 100 gm. This simulates lakes with drainage basins of three sizes and two different geologic substrates.
2) Collect actual basin material from a lake and use it as a substrate in your experiment.

3) Determine the amount of lime required to restore the most sensitive 'lake' to its original pH. Try the experiment again on the restored lake and see whether the treatment effect lasts.

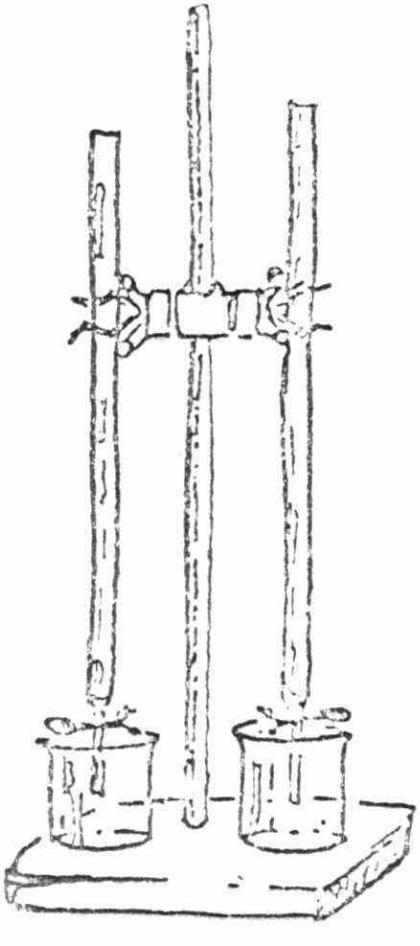
EXPERIMENT

The Effect of Acid Rain on Soil Types

Equipment

200 ml of an acid solution, pH range 2-3
pH indicator paper
2 plastic columns
crushed limestone
crushed granite
1 ring stand with support clamps
plastic tubing to fit columns
2 drain tube clamps
masking tape or marking pencils for glass
1 graduated cylinder (100 ml)
1 jug (to hold 200 ml of acid solution)
2 beakers
safety goggles
hammer
meter stick

1) Set up the apparatus as in the following diagram.



2) For each column, clamp the drain tubes securely.

3) Fill each column to a level of 30 cm with a different material. ie. granite, limestone (crushed)

4) For each column:
   a) Pour 100 ml of the acid solution into the graduated cylinder.
   b) Measure and record its pH value
   c) Pour this acid solution into the column.

5) After you have added the acid solutions to the columns, wait ten minutes.

5) Record your observations for each column. (ie. bubbles, noise, discolouration)

7) Drain the acid solutions from each column into separate collection beakers.

8) Measure and record the pH value

Variations

1) Try a variety of soil types; pure sand, clays, mixtures.

2) Take a soil sample. Add agricultural lime to another soil sample. Measure differences in change of pH of acid percolating through a soil sample versus the same soil with added lime.

3) Use acid solutions that have a pH which is more similar to the pH of rainfall where acid rain is a severe problem.

4) Collect rainwater and use it as the acid solution.

EXPERIMENT

The Effect of Acid Rain on Pond Organisms

Equipment

Gammarus (approx. 15)
glass containers - 100 ml (4), 500 ml (1), beakers, baby food jars, battery jars, canning jars, small acquaria
spring water - 500 ml for each jar (can use lake or stream water)
pH paper - range 2-7
labels/masking tape
culture dishes
pipettes - bulbs 2.5 cm in diameter, glass or plastic tubing with an internal diameter of 3 mm
10% H_2SO_4
dropper bottles
stirring rods

Optional Materials
monocular microscopes
steromicroscopes
hand lenses
depression slides

You can prepare the acid solutions before class or better, prepare the solutions as a class demonstration. Students can help you stir, add/count drops and take pH measurements. Use water from the pond or stream. The number of drops suggested in the chart below are estimates. As drops are added, be sure that you stir the solutions thoroughly. The pH must be stabilized before you use the solutions. (It is a good idea to let the solutions stand overnight in order that any released CO_2 could equilibrate).

Solution A	500 ml of spring water	pH 6
Solution B	500 ml of spring water + 5 drops 10% H_2SO_4	pH 5
Solution C	500 ml of spring water + 15 drops 10% H_2SO_4	pH 4
Solution D	500 ml of spring water + 25 drops 10% H_2SO_4	pH 3

Add 500 ml of spring water to a container. Measure the pH of the water, which should be about 6. Add 4 *Gammarus* to the container. Add green algae if available.

Part A - General Anatomy

Make a detailed sketch of Gammarus and label the parts; ie. eyes, antennae, legs (swimmer, jumper, crawler).

Part B - General Behaviour

Observe and record the behaviour of Gammarus for 10-15 minutes. Where, in the container, does it spend most of its time? What per cent of the time is spent moving? How is the rest spent? Does it use all of its legs in swimming? Which ones are used in jumping and climbing? Do Gammarus avoid each other? What do they do when they 'bump' into each other?

Learn more about Gammarus by touching it (gently) with a glass rod or toothpick. How sensitive is Gammarus to touch?

Part C - Experiment

1) Label four, 100 ml containers from pH 3 to pH 6.

2) Add 100 ml of the pH solutions to the containers as follows:
   a) container pH 3 - 100 ml of pH 3 solution
   b) container pH 4 - 100 ml of pH 4 solution
   c) container pH 5 - 100 ml of pH 5 solution
   d) container pH 6 - 100 ml of pH 6 solution

3) Check and record the pH in each container. The pH must be accurate.

4) Place two Gammarus in the pH 6 container. Record the time.

5) Place two Gammarus in the pH 3 container. Record the time and your observations. Is the behaviour normal? Is it different than previously recorded? Does Gammarus survive in this pH? If any organisms die, record the time of death.

6) Place two Gammarus in each of the pH 4 and pH 5 solutions and record the time.

Questions

1) What is the purpose of the solutions of different pH's?

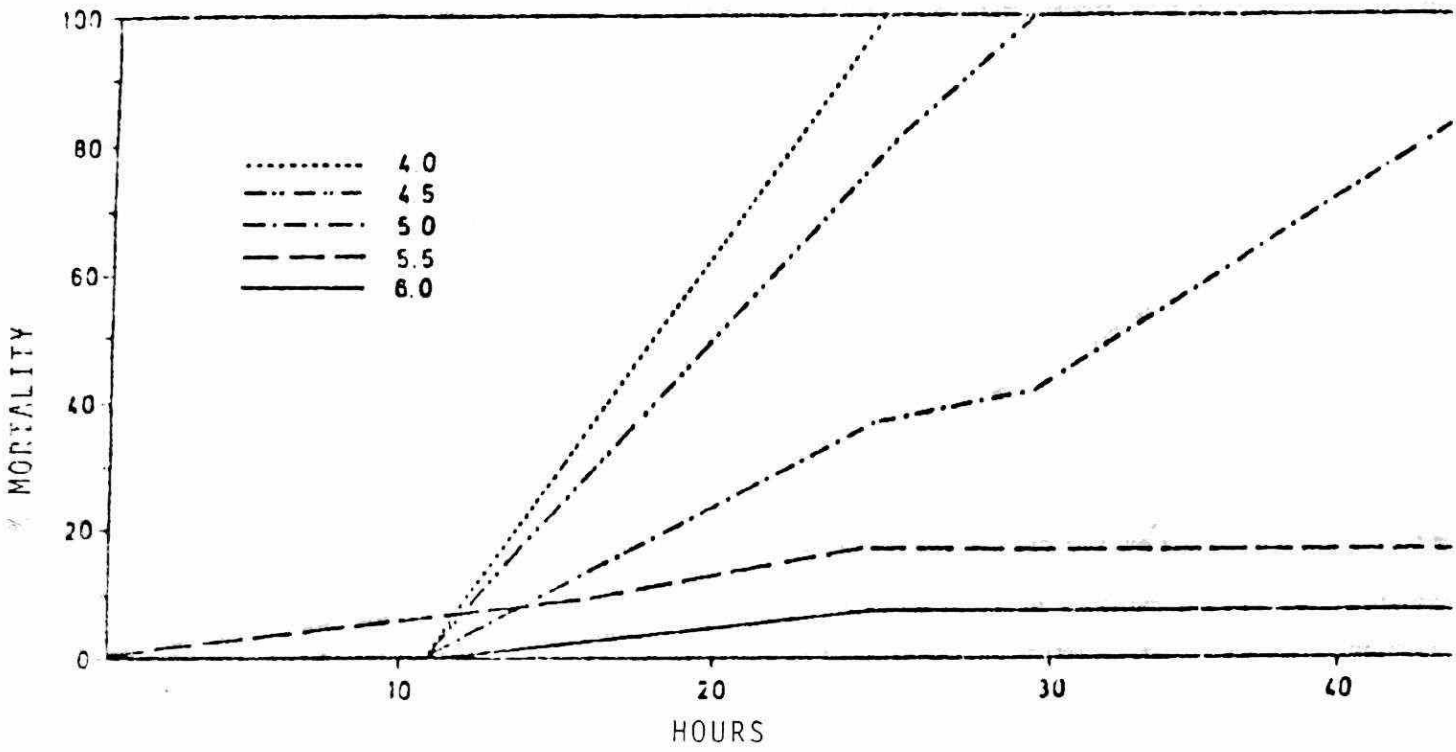
2) What would you need to know to make an educated hypothesis about what would happen to a food chain or web in a pond or stream if Gammarus became extinct? How could you find out?

3) If an early spring thaw produced a melt water of pH 5, what might occur to the population of Gammarus in a stream? To a population of Gammarus in a lake into which this stream flows? What if the pH of the melt water was 3?

4) What behavioural clues indicated that the animals were suffering or were in trouble?

5) Does Gammarus appear to be an organism that might be useful as an indicator of the relative health of an aquatic ecosystem? Why?

6) What does this graph mean?



Percent mortality of Gammarus adults exposed to indicated pH treatments in laboratory aquaria. Twenty adults, all over 1 cm long, were used in each treatment.

a) Which pH has the highest mortality?

b) Which pH has the lowest mortality?

c) For each pH, what is the % mortality at 10 hours? 20 hours? 30 hours?

d) What would you predict the mortality of Gammarus to be if it were placed in a solution of pH 2? pH 1? Is there a need to check these by experiment?

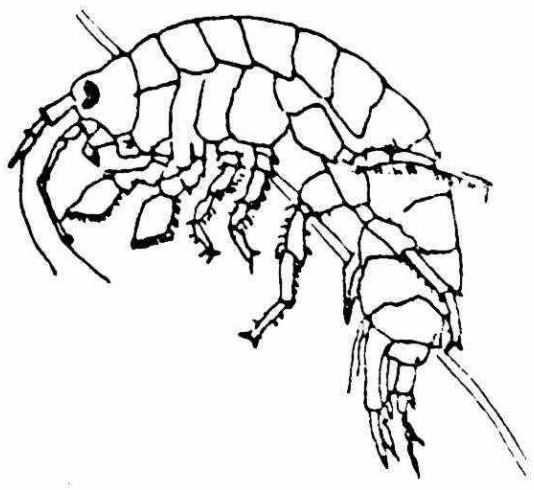
e) At what point does pH appear to be a limiting factor for Gammarus?

7) What is the difference between short-term and long-term effects? Do you think a fast test (short time period required to measure mortality) is indicative of what could happen in a long-term test at a less damaging pH?

Background Information

Gammarus are crustaceans found in ponds and streams. You may know them as amphipods or 'scud'. Gammarus are very active acrobats; they swim, they jump, they crawl, they are almost always on the move. A fish net is useful for catching them.

Once you know what and where to look for them (decaying vegetation, under stones and rocks) scud are easy to collect.



Gammarus Length Range
5-8 mm to 12-15 mm

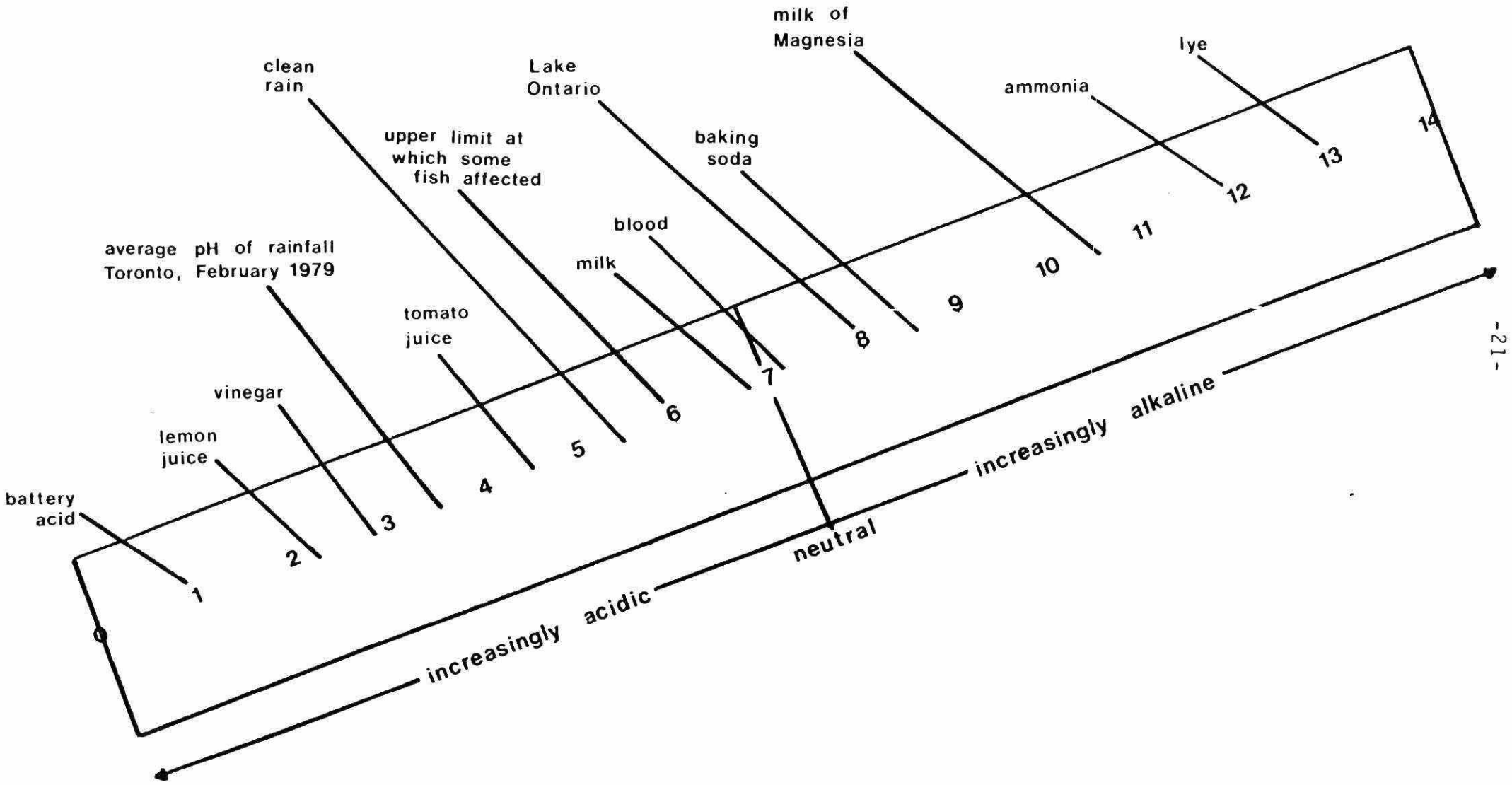
A drop in the pH level from 6 to 5.5 will cause the decline in the numbers and types of organisms in lakes. Those who do survive will experience problems in adapting.

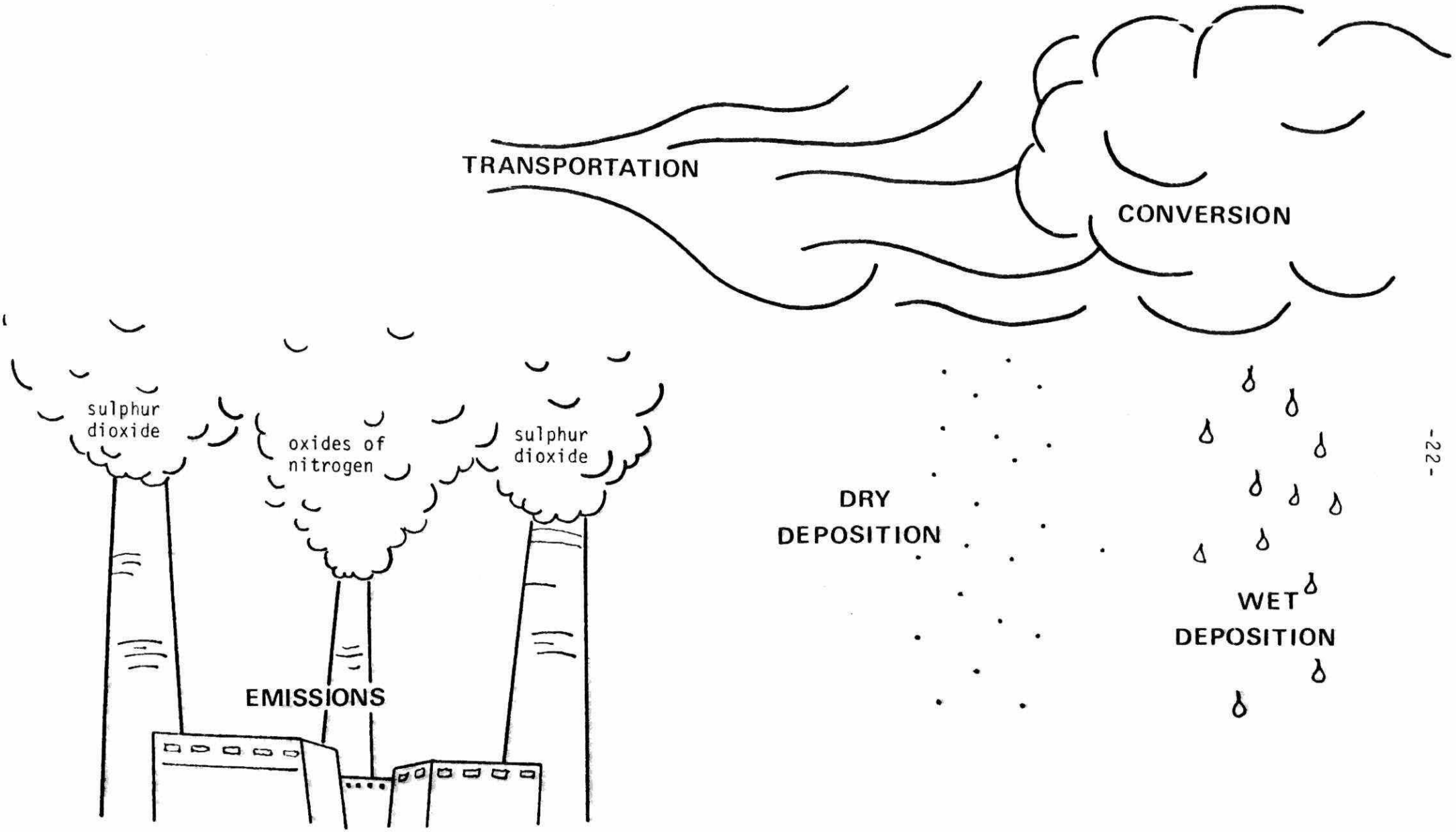
A pH drop of 5.5 to 5 signals the elimination of some species and reduced populations of the survivors such as the Crustacean zooplankton, watermites, algae, snails, clams, crawfish, frogs, salamanders, sideswimmers, fairy shrimp, most mayfly species and many stonefly species. However, some bottom dwellers such as midges, bloodworms, and other worms will increase in numbers as will several chitinous insects like the backswimmers, whirligig beetles and water boatmen.

If the pH drops from 5 to 4.5, the natural decaying process of dead plants and animal matter causes a buildup of humus, waste and debris. At this point, most fish species are dead. Aquatic flies such as the dragonfly, damselfly, alderfly, fishfly and caddisfly are capable of surviving these high acid waters.

Below pH 4.5, <u>all</u> fish and <u>most</u> aquatic life are gone.

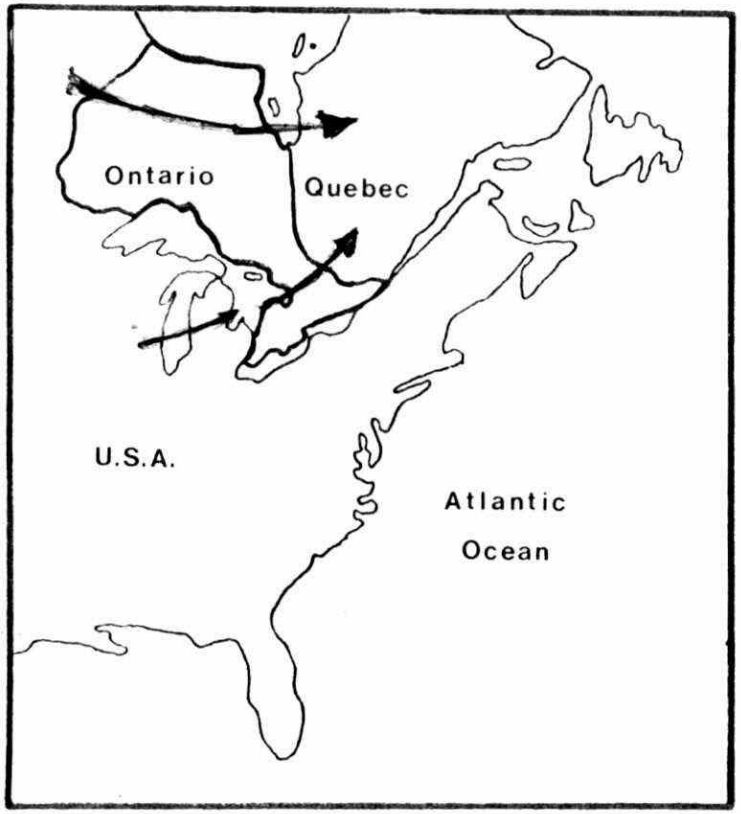
THE ACID TEST



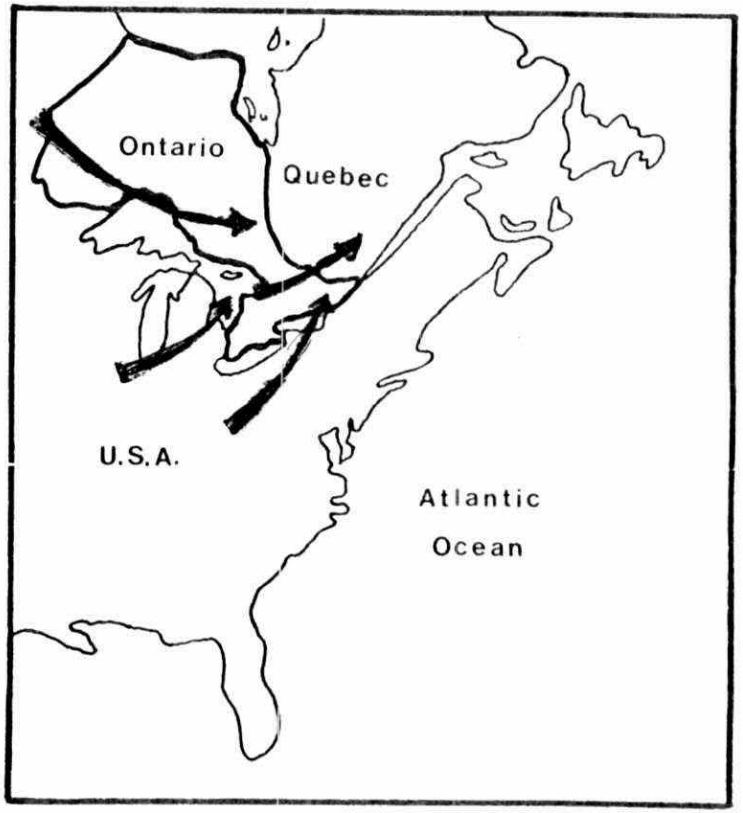

TRANSPORTATION
CONVERSION
sulphur dioxide
oxides of nitrogen
sulphur dioxide
EMISSIONS
DRY DEPOSITION
WET DEPOSITION

IMPORTANT STORM TRAJECTORIES OVER ONTARIO

SUMMER



WINTER



ACID RAIN STUDY SHEET

1) What are the pH's of the following substances?

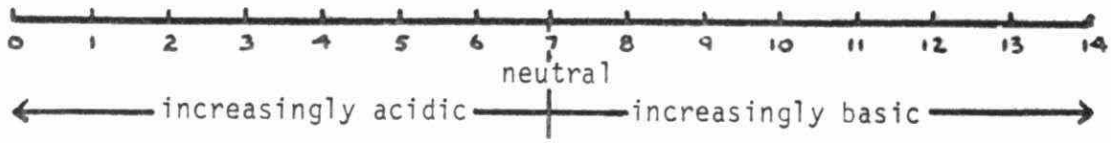
a) vinegar _____

b) distilled water _____

c) ammonia solution _____

d) rain water _____

Plot these values on the line given below. (pH scale)



Is rainwater acidic or basic? _____

2) List the four stages of acid rain production.

a) stage 1 _____
example _____

b) stage 2 _____
example _____

c) stage 3 _____
example _____

d) stage 4 _____
example _____

3) Acid rain originates in three main areas. Name them.

a) _____

b) _____

c) _____

4) What are the three main results of the acid rain problem?

a) _____

b) _____

c) _____

RAINY DAY PROGRAMS

INTRODUCTION

These are alternate activities that can replace any of the other studies in the event of inclement weather. Ecological principles will still be stressed.

OBJECTIVES

(1) To develop environmental concepts and an appreciation of nature even though poor weather conditions prevent outdoor activities to be carried out.

PREPARATION

Study Site

A large indoor play area or room will be needed to house film equipment and/or carry out active games.

Activities Beforehand

The original plans should be carried out until the last possible moment. However, a decision should be made with enough notice to be able to set-up for the alternate program.

Equipment Required

Film projector
Slide projector
Wollensak
Equipment for the Environmental Games chosen

ACTIVITIES

Three programs can be carried out:

(1) Film presentation
(2) Environmental games
(3) Indoor Nature Study

See the lesson plans involved for more definite procedures.

FOLLOW-UP ACTIVITIES

(1) Carry out the field study originally intended.

(2) Carry out follow-up activities for the Environmental Games or Nature Study sessions.